

METHOD FOR CONNECTING ONE OR MORE DEVICES WITH A MOBILE DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates generally to communication devices and more particularly connecting one or more devices with a mobile device.

BACKGROUND OF THE INVENTION

[0002] In a IoT environment, IoT device receive plurality of data from sensors or other connected devices. In order to transfer smaller amount of data received from one or more connected devices (sensors) to a mobile phone, a Bluetooth Low Energy (BLE) connection is used, however when large data is involved, a conventional Bluetooth (BT) connection is used for transmitting data, for example, voice or video call data.

[0003] The existing art involves, mobile phone and IoT device (for example, a smart wearable device) which are initially connected over BLE and when large data to be detected and needs to be transferred, the connection switches to BT. The IoT device manually or automatically switching ON the preconfigured Bluetooth hardware. Then Bluetooth hardware of IoT device initiates the pairing request with the mobile phone. During the course, the mobile phone may or may not show the pairing request initiated by the IoT device, due to the security issue of background connection. Then, the user selects and chooses pairing with the Bluetooth hardware of the IoT device, by disconnecting the existing BLE connection. This is a complex process, where the user initially identifies and pair with the BLE of the IoT device, when data to be transmitted to the IoT device is identified as 'large', then the other Bluetooth hardware (BL) in the same IoT device is switched on and again the pairing process with that BL hardware should be initiated and connected establishment should be done. In case, the user not paired the IoT device with Bluetooth hardware initially, then the user needs to manually switch on the Bluetooth hardware on the IoT device and then choose to pair with the mobile phone.

[0004] Hence, a novel method to connect a IoT device with the mobile phone irrespective of amount of data and to enable smooth transition from BLE to BL and vice-versa is suggested and the following specification provides an efficient connection establishment between the IoT device and the mobile phone and vice-versa.

SUMMARY OF THE INVENTION

[0005] In one aspect of the present invention, a system for establishing a communication, comprising, an IoT device, a mobile device and a first network. The IoT device and the mobile device are configured with at least two communication modules, wherein, a first

communication module of IoT device stores the name or address of a second communication module. The first network is capable of connecting the IoT device with the mobile device and vice-versa through a first connection established by the first communication modules configured in the IoT device and the mobile device and the mobile device configured with a mobile application, which is capable of executing a third set of instructions to fetch and receive the name of the second communication module of IoT device, through the first connection, initiating and establishing a second connection between the mobile device and the IoT device, wherein, the first and second communication modules are BLE and BT modules respectively and wherein the first and second connections are BLE and BT connection respectively.

BRIEF DESCRIPTION OF DRAWINGS

[0006] FIG. 1 is a first example system 100 in an embodiment of the present invention.

[0007] FIG. 2 is another aspect of example system 100 in an embodiment of the present invention.

[0008] FIG. 3 describes example connection establishment diagram illustrating the steps involved in subject BT module connection and pairing process.

[0009] FIG. 4 is a flowchart illustrating the initiating BT connection with IoT device through a BLE.

DETAILED DESCRIPTION

[0010] FIG. 1 is a first example system 100 in an embodiment of the present invention. As shown there, the system 100 comprises, an IoT device 110, a first network 120 and a mobile device 130. The IoT device 110 is connected with the mobile device 130 over the first network 120. The mobile device is configured with a mobile application, wherein, APIs of mobile application, is capable of connecting and communicating with the IoT device through one or more networking standards. The mobile application may send or transmit plurality of data to the connected IoT device. The IoT device 110 may comprise one or more communication modules to connect and communicate and transfer data with the mobile device.

[0011] In an embodiment, the communication modules of IoT device may communicate through first network 120, or second or third network (not shown) depending on the configuration of communication channel of first network 120, preconfigured between the IoT device 110 and the mobile device 130. The IoT device 110 is capable of accommodating and handling different types of hardware, such as one or more micro controllers or microprocessors, chip sets, memory, Bluetooth modules, power modules and other hardware components. In an embodiment, the Bluetooth hardware modules may be automatically switched on and off to

manage the power consumption of the IoT device 110, through one or more instructions received from the mobile device 130.

[0012] FIG. 2 is another aspect of example system 100 in an embodiment of the present invention. The IoT device 110 is configured with a BLE module 210 and a BT module 220. The BLE module may handle low data rate transmission such as sensor values etc, whereas, BT module may handle high data rate transmission such as voice call, music, video call etc. The mobile application configured in mobile device communicates with both BLE module 210 and a BT module 220. The following description specifies the manner in which to effectively connect a BLE module 210 and a BT module 220 of the IoT device 110 by the mobile device 120 in an embodiment of the present invention.

[0013] In one aspect the present invention, the mobile device is configured with a mobile application 230 (for example, a customized mobile application) which is capable of communicating with the one or more communication modules of IoT device 110, such as BLE and BT (210 and 220).

[0014] Firstly, the IoT device 110 advertises the name/address over BLE. On the other part, the user through mobile application 230 scans the location for available IoT devices.

[0015] Once a IoT device is found, User chooses subject IoT device 110 from the list of available devices for connection.

[0016] The mobile application 230 sends a connect BLE request to IoT device 110 and IoT device 110 returns with Connection successful. Once a connection is made between IoT device and the mobile device, data is transferred with the connected IoT device and vice versa based on the available services and characteristics. Now, the IoT device 110 (peripheral device) is connected with the mobile device 120 (a master device) over a BLE module 210 (BLE connection).

[0017] After connection, the mobile application 230 sends a request to discover services under BLE in the subject IoT device 110. The capabilities of the subject IoT device are discovered and IoT device 110 returns with the list of all available BLE services.

[0018] Each IoT device 110 have a Generic access profile (GAP), Generic Attribute Profile (GATT) and Attribute protocol (ATT). GAP controls connections and advertising in Bluetooth and also defines the details in which the communication of such IoT devices access and communicate with each other and with a master device.

[0019] Whereas, the GATT defines the way that two Bluetooth Low Energy devices transfer data back and forth using Services and Characteristics. GATT makes use of a generic data protocol called the Attribute Protocol (ATT), which is used to store Services, Characteristics

and related data in a simple lookup table using 16-bit IDs for each entry in the table. In other words, the GATT defines how data or attributes are formatted, packaged and sent across the connected devices according to one or more rules.

[0020] The peripheral device (IoT device) is known as the GATT Server, which holds the ATT lookup data and service and characteristic definitions, and the GATT Client (the mobile device/tablet), which sends requests to this server. All transactions are started by the main device, the GATT Client, which receives response from the secondary device, the GATT Server.

[0021] Attribute protocol which defines rules for accessing attributes or data on a device. A GATT profile of IoT device is built on top of attribute protocol. Profile is a collection of services compiled by Bluetooth SIG. For example, the Heart Rate Profile, combines both the Heart Rate Service and the Device Information Service.

[0022] Services are specific blocks of data called characteristics. A service can have one or more characteristics, and each service distinguishes itself from other services by means of a unique numeric ID called a UUID, which can be either 16-bit (for officially adopted BLE Services) or 128-bit (for custom related services). Characteristic encapsulates a single data point and may contain an array of related data, for example, X/Y/Z values from a 3-axis accelerometer, etc. In one example, Heart Rate Measurement characteristic is mandatory for the Heart Rate Service, and uses a UUID of 0x2A37. It may start with a single 8-bit value describing the HRM data format and includes the heart rate measurement data which matches subject configuration byte.

[0023] Further, the data is arranged in the form of attributes and each attribute may have a 16-bit attribute handle, a UUID, a set of permission and a value. Also, attribute protocol defines various read and write operations for attributes. In an embodiment, BLE services may include a custom defined service with service name 'BT module', wherein which stores unique characteristics/descriptors of BT module 220 (name or address of BT module 220) of the same IoT device 110.

[0024] After receiving the BLE services the mobile application 230 sends a request to subscribe to BLE characteristics and its descriptors. In an embodiment, user can specify the custom services and characteristics. Under one of the characteristics of the service, details of BT name and address are included, that is a first characteristic (for example) may store a value such as name and address of another Bluetooth (BT) module 220 configured in the same IoT device 110.

[0025] In an embodiment, the mobile application 230 is capable of selecting and using subject first read/write characteristics of the BLE services and IoT device 110 over BLE connection which retrieves the name and address of the BT device 220 configured in the same IoT device 110. Meanwhile, the mobile device through the mobile application calls the first instruction to connect and pair with the BT module (name and address retrieved) of IoT device, when this instruction is received by IoT device through BLE connection, BT module 220 of IoT device is automatically switched or turned on and advertises for a predefined time interval in order to get connected and paired with the mobile device 130. In another embodiment, the BT module 220 of IoT device 110 is always switched on to connect and pair with the mobile device 130 for the first time.

[0026] During BT connection and pairing, the mobile application 230 may automatically disconnects existing BLE connection with the IoT device 110 and the mobile application 230 identifies the BT device 220 configured in the subject IoT device 110 also returns with the value of being paired successfully with the IoT device 110.

[0027] The above process of connecting and pairing a BT module 220 with mobile device 130 may be initiated by the user at any time and above steps is repeated through the mobile application 230 and involves very minimal user intervention (limited to enable the connection and accept the pairing of BT), and the advantage is there is no specific interface or action need to be carried out at the IoT device 110 itself.

[0028] In one aspect of the present invention, a system 100 for establishing a communication, the system comprising a IoT device 110, a mobile device 130 and a first network 120. The IoT device 110 and a mobile device 130 are configured with at least two communication modules, where a first communication module of IoT device stores the name or address of a second communication module of subject IoT device. The first network 120 is capable of connecting the IoT device 110 with the mobile device 130 and vice-versa through a first connection established by the first communication modules (114 and 124) configured within the IoT device 110 and the mobile device 130, respectively. The mobile device 130 is configured with a unique mobile application 122, which is capable organizing, operating, executing, communicating, connecting and displaying one or more data in relation to the data received from the IoT device and an application server. In an embodiment, the mobile application stores plurality of instructions or set of instructions which are executed in time to time to provide various capabilities in relation to the hardware, firmware, sensors configured on the IoT device and the mobile device. In one aspect, the mobile application is capable of executing a first set of instructions to connect with the IoT device 110 through the first network 120, wherein, the

mobile device 130 and the IoT device 110 are connected over a first connection established by the first communication module 114. The first communication module 114 is a BLE module and the first connection is a BLE connection.

[0029] Further, the mobile application of mobile device 130 is capable of executing a second set of instructions to fetch a name or address of a second communication module 118 which is stored within the first communication module 114 of IoT device 110. Also, the mobile application, receives the name or address of second communication module 118 of the IoT device 110 at the mobile device 130, through the first connection. The second communication module is a BT module. The mobile application executes a third set of instructions to establish a second connection between the second communication modules (118 and 128) of the IoT device 110 and mobile device 130, based on the name or address of second communication module 118 of IoT device 110. The second connection is a BT connection established between the IoT device 110 and the mobile device 130. The mobile application executes a fourth set of instructions to automatically disconnect the first connection established between the first communication modules (114 and 124) of the IoT device 110 and the mobile device 130. The first and second connection supports lower and higher data rate transmission respectively, between the IoT device 110 and the mobile device 130. In an embodiment, the mobile application 122 of mobile device 130 may execute another set of instructions to reconnect with the IoT device 110 over a first communication network, establishing a first connection. Further, the mobile application 122 may anytime switch between first connection and second connection and vice versa, when there is a need and requirement in at least at the IoT device 110 or mobile device 130 or both.

[0030] FIG. 3 describes example connection establishment diagram 300 illustrating the steps involved in subject BT module connection and pairing process. The IoT device is configured with BLE module and BT module, wherein, initially BLE module of IoT device advertises and mobile device responds with the following steps include,

[0031] Step 1: user chooses IoT device from a list having plurality of IoT devices which are being advertised.

[0032] Step 2: connect with the IoT device through a BLE connection and Pairing with the subject IoT device is optional step.

[0033] Step 3: BLE connection is successful between IoT device and the mobile device.

[0034] Step 4: Mobile device sends request to 'discover services BLE' in subject IoT device.

[0035] Step 5: All available BLE services are fetched from IoT device and sent to mobile device.

[0036] Step 6: Mobile device initiate BLE subscription and receive BLE characteristics/descriptors.

[0037] Step 7: Mobile device fetches BT name/ address using BLE with relevant write/read characteristics. In an embodiment, in IoT device through read/write characteristic may implement an instruction to return the name/address of Bluetooth (BT) module configured in the same IoT device.

[0038] Step 8: Mobile device receives BT name / address of subject IoT device over the BLE connection.

[0039] Step 9: The mobile device through the mobile application calls the first instruction to connect and pair with the BT module of IoT device, when this instruction is received by IoT device through BLE connection, the IoT device automatically switches on the Bluetooth module hardware for a predefined time interval (for example, 30seconds to 1 minute) to connect and pair with the mobile device. In an embodiment, the BT module of IoT device is always switched on to connect and pair with the mobile device for the first time.

[0040] Step 10: The mobile device through the mobile application calls the second instruction to proceed, connect and pair to the Bluetooth module of the IoT device through the name / address provided. In an embodiment, the BT module is auto switched off after the predefined time interval, to conserve power. In another embodiment, the user at any time may initiate above Step 9 and Step 10 to connect and pair to the Bluetooth module of the IoT device.

[0041] Step 11: Mobile device and IoT device are successfully paired and connected over BT. The BT module is capable of handling high data transmission with the mobile device. Further, BT connection may disconnect with mobile device and may be turned off when there is a low data rate is found. In an embodiment, the IoT device connects with the mobile device over the BLE connection. In an embodiment, the mobile application is capable of identifying data transmission to be received by the IoT device and switches the connection between BLE to BT and vice-versa depending on the need and amount of data to be transmitted to the IoT device. In another embodiment, the IoT device may be a smart watch, smart wearable device, smart jewellery or any smart device. In another embodiment, after the pairing, the configured BT module connects with the mobile device when high data transmission is initiated by the mobile application, such as voice calling function. The auto connection and disconnection of BLE and BT modules of IoT device is monitored by subject mobile application, in real time.

[0042] FIG. 4 is a flowchart illustrating the initiating BT connection with IoT device through a BLE. In step 410, the mobile device configured with a mobile application connect with a IoT device in the vicinity, through a BLE connection. Both mobile device and IoT device is

configured with a BLE module and a BT module. When the request from mobile device is received by the IoT device through a BLE connection, the IoT device responds to mobile device with a 'BLE connection successful' message. In step 420, the mobile device executes one or more instructions to discover services BLE in the subject IoT device. When the IoT device is connected over BLE, BLE provides several services (which are preconfigured or custom made) for which mobile device may make use.

[0043] In step 430, the mobile device subscribes to BLE characteristics/descriptors. The IoT device provides various services and mobile device may subscribe to a particular service and may read or write value. The services may be relating to one or more sensors configured in the IoT device, for example, the IoT device is a heart rate monitor device, then the device may have a Heart Rate Profile with a service 'Heart Rate Measurement characteristic'. The characteristic may be configured as read, write or both, where the data is written on the characteristic. In an embodiment, a first service is a first characteristic and may store the subject IoT device's Bluetooth (BT) module name and address.

[0044] In step 440, the mobile device sends instructions to fetch the BT name (Bluetooth module name) and/or address. The first service which is called, returns with the IoT device name. In step 450, the mobile device initiates BT pairing with the received name or address of the IoT device. The mobile application configured in the mobile device is capable of one or more instructions to automatically initiate a Bluetooth connection (BT) with the IoT device, through the name/address received. Meanwhile, the BLE connection existing between the mobile device and IoT device is automatically stopped and disconnected, enabling BT connection. In an embodiment, the BT module of IoT device pairs with the mobile device, establishing a peripheral and master type communication, which handles and may exchange higher rate of information. Now, the mobile application of mobile device is capable and may able to switch between BLE or BL connection with the IOT device, with minimal intervention.

[0045] In another aspect of the present invention, a new and innovative method is being proposed to handle the pairing and connecting process between a mobile phone and a IoT Device, where the IoT Device supports both BLE and Bluetooth (like a smartwatch that support Bluetooth calling). Due to the power demands of the Bluetooth, the Bluetooth hardware is switched off in these devices unless required. The proposed method is as follows,

1. Connect to BLE
2. The device will implement a command to return the Bluetooth device address and name

3. When this command is called, the device automatically switches on the Bluetooth hardware for a predefined time interval (it has to then auto switch off to conserve power)
4. The App requests the Bluetooth device address and name
5. The App proceeds to connect and pair to the Bluetooth device via the address provided
6. In case the user chooses to connect the Bluetooth later, the entire procedure can be repeated with minimal user intervention (User intervention is limited to enable the connection and accept the pairing). No special interface is needed on the device itself.

[0046] In another aspect of the present invention, a method of establishing a communication between a mobile device and a IoT device, the method comprising, scanning, by the mobile device, to detect one or more IoT devices in the vicinity, identifying at least one IoT device, establishing a first connection between the IoT device and the mobile device through the first communication modules, by executing a first set of instructions, sending and executing second set of instructions to fetch a name of a second communication module configured within the IoT device, fetching and receiving, the name of the second communication module, at the mobile device, in response to the execution of one or more instructions at the IoT device and initiating a second connection between the mobile device and the IoT device through the second communication modules configured therein, by executing third set of instructions. The method further comprises following operations provided therein are part and are executed at the IoT device, receiving one or more instructions, at the IoT device, to discover services provided by the first connection and first communication module of the IoT device, calling at least one service from the plurality of services provided by the first communication module, wherein, subject service stores a name of second communication module and subscribing to one or more characteristics and descriptors of at least subject selected service, wherein, subscription of service enable read/write within characteristics and descriptors. The services are relating to one or more sensors, communication modules, power module, micro controller configured within the IoT devices. The mobile device is capable executing a fourth set of instructions to automatically disconnect the first connection established over the first communication modules of the IoT device and the mobile device.

[0047] While various embodiments of the present disclosure have been described above, it should be understood that they have been presented by way of example only, and not limitation. Thus, the breadth and scope of the present disclosure should not be limited by any of the above-discussed embodiments but should be defined only in accordance with the following claims and their equivalents.

Claims

I/ We claim,

1. A system for establishing a communication, the system comprising:
 - an IoT device and a mobile device configured with at least two communication modules, wherein, a first communication module of IoT device stores the name or address of a second communication module of subject IoT device;
 - a first network capable of connecting the IoT device with the mobile device and vice-versa through a first connection established by the first communication modules configured in the IoT device and the mobile device; and
 - the mobile device configured with a mobile application, and is capable of executing a first set of instructions to connect with the IoT device through the first network, wherein, the mobile device and the IoT device are connected over a first connection established by the first communication module.
2. The system of claim 1, further comprising:
 - the mobile application of mobile device is capable of executing a second set of instructions to fetch a name of second communication module stored within the first communication module of IoT device; and
 - the mobile application, is capable of receiving the name of second communication module of the IoT device at the mobile device, through the first connection.
3. The system of claim 2, wherein, the mobile application executes a third set of instructions to establish a second connection between the second communication modules of the mobile device and the IoT device;
4. The system of claim 2, wherein, the mobile application executes a fourth set of instructions to automatically disconnect the first connection established between the first communication modules of the mobile device and the IoT device.
5. The system of claim 1, wherein, the first and second communication modules are BLE module and the Bluetooth module, respectively.
6. A method of establishing a communication between a mobile device and a IoT device, the method comprising:
 - scanning, by the mobile device, to detect one or more IoT devices in the vicinity;
 - identifying at least one IoT device;
 - establishing a first connection between the IoT device and the mobile device through the first communication modules, by executing a first set of instructions;

sending and executing second set of instructions to fetch a name of a second communication module configured within the IoT device;

fetching and receiving, the name of the second communication module, at the mobile device, in response to the execution of one or more instructions at the IoT device; and

initiating a second connection between the mobile device and the IoT device through the second communication modules configured therein, by executing third set of instructions.

7. The method of claim 6, further comprising:

receiving one or more instructions, at the IoT device, to discover services provided by the first connection and first communication module of the IoT device;

calling at least one service from the plurality of services provided by the first communication module, wherein, subject service stores a name of second communication module; and

subscribing to one or more characteristics and descriptors of at least subject selected service, wherein, subscription of service enable read/write within characteristics and descriptors;

8. The method of claim 7, wherein, the steps and operations provided therein are part and are executed at the IoT device.

9. The method of claim 7, wherein, the services is relating to one or more sensors, communication modules, power module, micro controller configured within the IoT devices.

10. The method of claim 6, wherein, the mobile device is capable executing a fourth set of instructions to automatically disconnect the first connection established over the first communication modules of the IoT device and the mobile device.