AN APPROACH TO IoT APPLICATIONS: SELF CONFIGURATION AND SMART CONNECTION SYSTEM WITH WIRELESS SENSOR NETWORKS AND ZIGBEE TECHNOLOGY

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Abstract: The rapid development of wireless communication technology facilitates the realization of the Internet of Things (IoT). Self-configuration and smart connection system have become relative important issue in accordance with extensive applications of IOT, and the energy saving concepts. Therefore, this work presents the integration of 'Self-configuration and Wisdom Connection System' with Wireless Sensor Networks (WSN), IOT and ZigBee technology, to actualize self configuration based on a received signal strength indicator Received Signal Strength Indicator (RSSI), lighting auto configuration area, regional allocation, and sub-areas. The proposed 'Self-configuration and Wisdom Connection System' automatically configures different lightings to the same position within in the range -3dBm when the RSSI value varies only slightly. In this project there are environmental sensors which save energy whenever the person enters then according to that the sensors will work. Basically electrical devices are power hungry; in order to reduce the power consumption we are going for this project. Whenever the PIR sensor will activate then only the sensor network will be activated. In this project we are using the PIR for the person identification .whenever the sensor values exceed, and then the relevant operations will be performed.

Keywords: Zigbee, sensors, Wi-Fi, IoT, Smart Home, Self-configuration.

I. INTRODUCTION

The initial rapid development of wireless communications technology was motivated by the need for military detection applications. Since then, ZigBee technology has been extensively used in a large range of fields, providing communications and sensing with the low power consumption, high reliability, and multi-node networking. Today, this technology is extensively used in such applications as process monitoring in industry, consumer products for health testing, home electronic devices for monitoring or detecting intruders, medical sensing, elderly care, the collection of patients' information, such as blood pressure, heartbeat, and pulse, and environmental applications such as the detection of pollution water, air and soil using sensors. The popularity of smart devices has resulted in new applications of WSN, the new IoT and ZigBee technology [1].With respect to the consumer market, ZigBee-related technologies have been available for a long time but not yet universally so. For example, the costs, installation and operational complexity of such technologies still affect the acceptance by consumers. Developments that make wireless technologies seamlessly bind to all types of home appliances; eliminate cumbersome setting, and cause users to feel that using a remote controller is as simple as using a cell phone may provide new opportunities in the IoT. This paper proposes a 'Self-Configuration and smart Connection System' that integrates WSN, the IoT and ZigBee technology, and confirms its feasibility in

both theory and practice. Lighting control systems with sensors are constructed with Self-configuration and smart lighting control. The system configures lighting based on RSSI information of reference points, and provides information about lighting RSSI for controlling devices, facilitating reference alignment. Moreover, this work proposes the concept of sub-area regional configuration, changing sub-area range by setting RSSI error, to increase controlling in lighting numbers and to enhance the effectiveness of automatic control. This paper is organized as follows. Section 2 presents proposed scheme. Section 3 shows the architecture and functional design of the proposed system. Section 4 discusses the methodology. Finally, conclusions are drawn presented.

II. PROPOSED SCHEME

Here, the comprehensive system architecture and its primary components are discussed in Section III-A and Section III-B and Section IV describes the detailed workflows of the proposed Universal Android Remote Controller self-configuration and smart connection system. The key features of device control profile are presented in these below figures:

a. Transmitting section

b. Receiving section

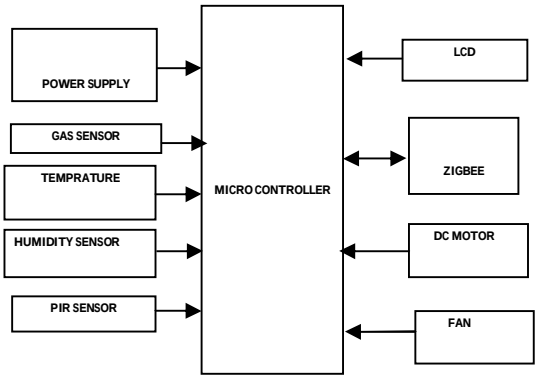

Fig 1: Transmitting section

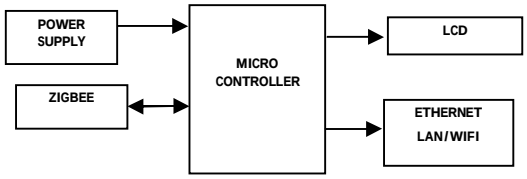

Fig 2: Receiving section

III. System architecture and functional design

Figure 3 presents the architecture of the Self configuration and smart connection system; it is composed ZigBee devices, sensors, lights and other components. The system is operated using a ZigBee remote controller, tablet or mobile phone through an Ethernet or Wi-Fi.

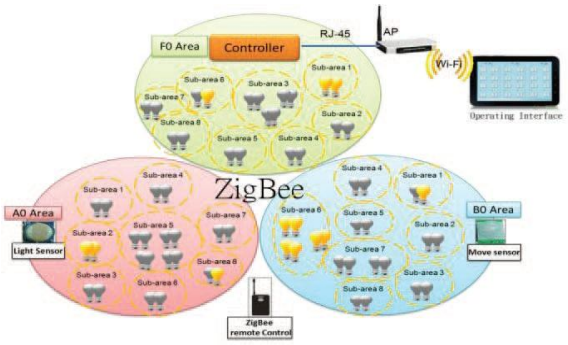

Fig 3: System Architecture

The system is divided into controller, light sensing area, and movement sensing area. They are three independent areas virtually, as follows:

 Controller

1) The controller is coordinator at the center of ZigBee network and is responsible for sending and receiving control commands. The coordinator communicates wirelessly with all ZigBee devices via ZigBee interface.

2) Software / Flash: The application program for ZigBee devices was developed using Z-Stack software and burned onto Flash memory. Flash memory provides archiving and records the parameters of lighting devices.

3) The Ethernet interface is the external gateway to the ZigBee network. Users operate the self-configuration and smart connection system over Wi-Fi or the Internet interface.

 ZigBee lighting consists of a ZigBee device with two LED lights, of which both or one can be lit. Lighting sites are determined from the RSSI values of three reference points. ZigBee lighting includes a burning function and a Flash archive.

 The GUI Platform is a user-operated interface that is programmed by C#.NET/Microsoft .NET Framework.

A. Packet Format

Figure 4 schematically depicts the sending and receiving of packets in the proposed system. The controller receives packets that are returned from ZigBee devices and sends the device status to operating interface, which then sends commands to ZigBee devices through the controller.

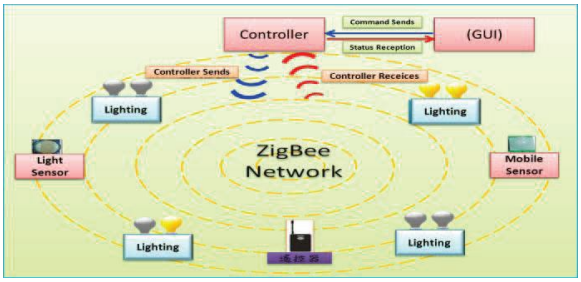

Fig 4: Structure of Sending and receiving packets

The controller receives wireless signals from lightning devices, sensors, and remote control backhaul. The fixed packet length is 10 bytes and packets are sent to operating interface via Ethernet interface. Figure 5 shows the format of received packets.

byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7	byte 8	Byte 9	Byte 10
Header	Header	Area Num	Device Num	Control Status	Connection Status	Scope Value	F0 RSSI	A0 RSSI	B0 RSSI

Fig 5: Format of received Packets

The controller sends commands wirelessly to lighting devices, sensors or the remote control device. The fixed packet length is 6 bytes. Figure 6 shows the transmission of the control commands.

byte 1	byte 2	byte 3	byte 4	byte 5	byte 6
Header	Header	Area Num	Device Num	Control Inst	Connection Status

Fig 6: Transmission of Control Command

The controller or remote controller transmits site allocation commands wirelessly to lighting devices. The fixed packet length is 6 bytes. Figure 7 shows the transmission of site allocation commands.

byte 1	byte 2	byte 3	byte 4	byte 5	byte 6
Header	Header	Area Num	Device Num	Config Inst	Error Range

Fig 7: Transmission of Site Allocation Command

B. Functional Development and Design

The self-configuration and smart connection system is developed to perform three major functions, which are lighting self-configuration, smart connection control, multifunctional remote control, based on the immediate collection of the RSSI and its distribution application. All equipment has an automatic saving mechanism. Table 1 presents the functional details, which are described in the following sections.

Table 1 Functions of Self-configuration

Function	Items
Self-configuration of lamps	1. Allocation sites of Setting new lamps (single / multi-lamp)
	2. Reallocation sites of lamps (single / multiple lamps)
	3. Clear lamp sites (single / multiple lamps)
	4. Allocation sites of area (single / multiple lamps)
	5. Query or delete site *location* record (single / full area)

The self-configuration adds and manages wireless lighting, sensing, or other devices to relieve the user setting problem. When performing site allocation, the system will determines the area in which the site will be, based on the RSSI values of the default reference points, and will save the records of the sited lighting devices. When the error range is preset to 0, only one

lamp can be allocated to each sub-area. When RSSI error range is applied to the site allocation process, the system compares the error range to RSSI value of the sited lighting, and assigns same lighting number. If error range is within a single sub-area; therefore, number of lighting devices in each sub-area is unlimited, and this scenario is called range site. The system can support 100 areas, each comprising eight sub-areas. The proposed system includes three areas, each of which consists of eight sub-areas.

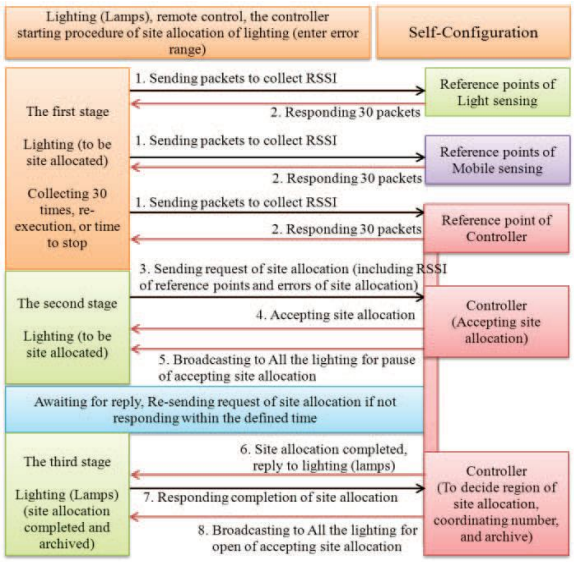

Fig 8: shows the procedure of site allocation

III. METHODOLGY

Micro controller: This section forms the control unit of the whole project. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is name of a class of processors, and is the name of a kind technology too.

Liquid-crystal display: LCD is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. They do not emit light directly.

Temperature sensor: Thermistors are widely used as inrush current limiter, temperature sensors (NTC type typically), self-resetting over current protectors, and self-regulating heating elements. TMP103 is a digital output temperature sensor in a four-ball WCSP and is capable of reading temperatures to a resolution of 1°C.

Co2 sensor: They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen, smoke. The Rs is obtained through effected voltage signal output of RL which series-wound and its relationship between them is:

Rs\RL = (Vc-VRL) / VRL

Fig 9: CO2 sensor, Temperature sensor

PIR sensor: A Passive Infrared sensor (PIR sensor) is an electronic device that measures IR light radiating from objects in its field of view. PIR sensors are often used in construction of PIR-based motion detectors. Apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall. It is usually infrared radiation that is invisible to human eye but can be detected by electronic devices designed for such a purpose. Thus, infrared means below energy level of color red, and applies to many sources of invisible energy.

Fig 10: PIR Sensor

ZIGBEE: Zigbee modules feature a UART interface, which allows any microcontroller to immediately use services of Zigbee protocol. It should be ensured that host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as 74LVTH125 when the host is directly connected to the XBee UART. X- Bee RF Modules interface to a host device through a logic-level asynchronous Serial port and it must presented be in asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because input data goes directly into input of a UART within X-Bee module, no bit inversions are necessary within asynchronous serial data stream.

Fig 11: Exterior and interior of ZB2530-LAN and Module

Wi-Fi: Wi-Fi is a family of computer networking technologies for LANs and MANs. It was commercially introduced in 1980 and first standardized in 1983 as IEEE 802.3, and has since been refined to support higher bit rates and longer link distances. The primary alternative for contemporary LANs is not a wired standard, but instead a wireless LAN standardized as IEEE 802.11 and also known as Wi-Fi.

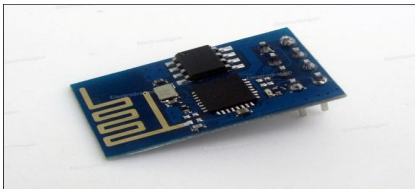

Fig 12: Wi-Fi module

Received signal strength indication (RSSI)

In wireless location, two main types of methods are used to convert signals into distances. The first, in which the arrival time of the signal is converted, includes time of arrival measurement method Time of Arrival (TOA) and the time difference of arrival method Time Difference of Arrival (TDOA) [8]. The second, in which distance is calculated from the strength of the received signal, includes the use of RSSI [9, 10]. RSSI is a simpler and easier method than TOA or TDOA for measuring distance, as it requires neither nanosecond-resolution equipment nor samples of long-term measurements, but it suffers from small errors associated with multipath interference and fact that strength of received signal diminishes as distance increases. The RSSI is calculated from RSS, as in according to Equation 2-1 and 2-2. PRX is strength of signal that is received by receiving node; PTX is energy intensity of the transmitting node; GRX is antenna gain of the receiving node; GTX represents antenna gain of the transmitting node; λ is wavelength of signal, and d is distance between antennas of two nodes and in a list of non-clauses, separate the items by commas, and the final two items by without a preceding comma. Substituting PRX into Eq. 2-2 yields RSSI. Pref is a reference power and is 1mW.

$$P_{RX} = P_{TX} \cdot G_{TX} \cdot G_{RX} \left[\frac{\lambda}{4\pi d}\right]^2 \qquad (2-1)$$

$$RSSI = 10 \cdot log \frac{P_{RX}}{P_{ref}} \qquad (2-2)$$

$$RSSI = -(10n \log_{10} d + A) \qquad (2-3)$$

RSSI is transmission power from the sending node to

receiving node, which changes with distance between two nodes. According to propagation model in Eq. 2-3,the received signal is converted into RSSI, in which A is received RSSI value 1m away from the receiving node; n is the signal propagation constant, which is also known as propagation constant or exponent, and d is distance between transmitter and receiver in meters.

IV. CONLCUSION

With respect to the consumer market in ZigBee-related technologies have existed for a long time but are not yet universally used. With regard to smart families as an example, costs, system installation and operational complexity affect consumer acceptance. The seamless binding of wireless technologies to all types of home appliances, elimination of cumbersome setting, and causing users to feel that using a remote control is as simple as using a cell phone may provide new opportunities related to IOT. In this work, the 'Self configuration and Smart Connection System' is developed its feasibility verified. The results of verification of its major functions, Self-configuration, indicate that system provides self-configuration for multi-lighting, with an RSSI value variation within -3dBm, and regional configuration in each sub-area validated.

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