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# A SMART INDUSTRIAL GATEWAY

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Abstract: These papers presents design and practical implications of smart industrial gateway which collects the data from the ble device and transfer it on Modbus RTU and Ethernet for monitoring the data remotely, most of the industry need the solution for data monitoring of multiple devices with less network traffic and minimal wiring, so this paper focused on this issue. Many industries use large mechanical machines to handle heavy loads and to operate multiple devices at the same time requiring wires connected to computers and equipment which increases wiring mixing and reduces power generation. To overcome this, wireless channels can be used instead of wires.

# Index Terms –BLE, Gateway, RTU, Ethernet, Power over Ethernet (POE)

# I. INTRODUCTION

A lot of advancement and significant changes are occurring in the field of technology. The way of interacting and communicating with humans and other devices is changing and getting better day by day. In recent years, with the rapid change in technology, various low-power wireless technologies have been developed and widely used. There is a growing interest in using technologies in various industries. A number of industrial projects have been conducted in areas such as agriculture, food industry, environmental monitoring, security surveillance, and others. To provide high-quality services to end users, Technical standards need to be formulated to clarify the details for the exchange, processing and communication of information between things. The success depends on standardization, interoperability, compatibility, reliability and Effective operations. This paper presents the design and practical effects of blades on industrial gateways. A gateway is a piece of networking hardware or a piece of software used for a network that allows data to flow from one network to another. Gateways communicate using multiple protocols to connect to multiple networks, which are different from routers or switches and can operate at any of the levels Transmission Control Protocol (TCP). The gateway is a combination of Bluetooth + Ethernet module, which can communicate with anyone Transfer data to server using BLE compatible device and on-board Ethernet Module. Basically the interaction between the Bluetooth module and the Ethernet module occurs via UART. Their combination will allow more accurate localization. We are able to communicate and send data back and forth. Without a gateway using the Internet would not be useful to us. Ethernet cable is a common network cable used with wired networks. Ethernet cables connect devices such as switches to PCs, routers and local area networks. These physical cables are limited by length and durability. If a network cable is too long or of poor quality, it won't carry a good network signal. These limits are one reason for good network signal. There are different types of Ethernet cables that are optimized to perform certain tasks in specific situations. Ethernet is a great technology to reduce operating costs. This is one of the many reasons why it benefits from wider industries than ever before. With a wide range of products relying on Ethernet, the need for new standards is growing. Ethernet has gained access to many network applications around the world.

# **II. EXISTING SYSTEM**

Industries today do lot of work and heavy load lifting than they were years back. All of this was controlled manually by human being and after sometime industrial revolution happened. Old traditional techniques were replaced by electronically controlled machines but they needed lot of wires to control motors basic functionality so this became tedious task. As now wireless communication has been introduced, everything can be controlled wirelessly. Improved data communications lead to faster transfer of information, because wireless technology allows the user to communicate when you are rarely out of touch - you don't need extra cables or adaptors to access office networks. Wireless transmission is more likely to be attacked by unauthorized users, so you should pay special attention to security.



Fig. 1 Industry Advancement

In exiting Bluetooth to Wi-Fi gateway, the transfer information or communication takes place in half duplex mode i.e. one direction. The Ble to Ethernet gateway is useful in bidirectional communication between the Bluetooth devices with the host server. Wireless network security primarily protects wireless networks from unauthorized and malicious access attempts. In short, wireless network security is delivered by wireless devices (usually a wireless router / switch) that encrypts and secures all wireless communications by default. Although wireless network security has been compromised, the hacker is not able to see traffic / packet content in transit. Furthermore, the wireless intrusion detection and prevention system also enables protection of the wireless network by alerting the wireless network administrator in case of security breach.

# I. LITERATURE REVIEW

This section outlines the different distributed fault detection and recovery techniques and their relative advantages and disadvantages. The rapid growth makes the standardization difficult. However, standardization plays an import role for the further development and spread of technology. Standardization aims to lower the entry barriers for the new service providers and users, to improve the interoperability of different applications/systems and to allow products or services to better perform at a higher level.

The work in 2005, locating the nodes cooperative localization in wireless sensor networks. In this article, the authors describe the measurement-based statistical models useful to describe time-of arrival (TOA), angle-of arrival (AOA), and received-signal-strength (RSS) measurements in wireless sensor networks this article has provided a window into cooperative localization, which has found considerable application in adhoc and wireless sensor networks.

In 2007, Survey of wireless indoor positioning techniques and systems. Three typical location estimation schemes of triangulation, scene analysis, and proximity are analyzed. Consider location fingerprinting in detail since it is used in most current system or solutions. Many wireless beacons like Bluetooth, Wi-Fi, Zigbee and they consider Bluetooth to be the best communication module for indoor or home conditions.

The work in 2018, gateway mechanism is presented to overcome Low power wireless LAN to IOT bridging. In this case, many low-power wireless interfaces and protocols such as Bluetooth low energy, ZigBee, Thread, and others are popular for smart home and smart industry sensor mesh applications. However, as developers are finding out, these RF protocols were designed before the Internet of Things (IoT) became a reality, and as such typically lack interoperability with Internet protocols (IPs) IPv4 and IPv6 making it challenging to connect designs to the IoT for smart sensing, automation, and control. Cloud connectivity is essential to maximize the benefits of smart wireless technology, yet it remains a tough technical challenge because of the lack of interoperability between the popular low-power wireless protocols and IP. A convenient and rapid solution is to employee an IoT gateway, a drop-in device that bridges wireless sensor networks to the cloud with minimal design overhead.

In 2020, A Survey on Devices, Gateways, Operating Systems, Middleware and Communication. In this era of research and technology, Internet of things (IoT) takes a prominent part in the evolution of applications of the various fields like health, education, smart cities, homes, agriculture etc. This paper provides a survey of the IoT ecosystem. All the components of IoT and their significance have been elaborated. The smart sensors collaborate through wireless communication and internet, with zero human activity, to deliver automated intelligent applications. In the future we will deal with testing the influence of broadcasting parameters of beacons such as the advertising interval and the TX power. It will also be suitable to test even higher density of beacons.

# **III. SYSTEM MODEL**

The Ble to Ethernet Module is useful in bidirectional communication between the Bluetooth devices with the host server. The gateway device has its own ble which act as a master and scan for available ble devices nearby. The master can connect up to 7 slave device and communicate with them simultaneously. The master establishes a Ble network and serves as a bridge between the server and the device. When the user want to send the data to the devices the user simply change the server field and then the server transfer the packet using Ethernet using Lwip protocol. The gateway receive over Ethernet port and transfer the data to the particular Bluetooth device where user want to send after the data transfer the device send the acknowledgment to the server., if user want to read the data available on devices then in same way the data is transferred from the ble device to the server. After data transfer the server send the acknowledgment to the device. The gateway device update the server about the device connection status like the derive is connected or not. The same gateway **a**lso has a capability to communicate over the modbus protocol it has Rs485 serial communication which is widely used in industry for field bus communication. Providing a clever way for sensors to communicate with the server.



Fig 2. Block Diagram BLE to Ethernet Gateway

This section presents the components and the pro-posed model. The hardware components used in the proposed system is below:-

- STM32 F767ZIMicrocontroller
- BLE
- RS485
- Power Over Ethernet

1] STM32 F767ZI: The STM32 board provides an affordable and flexible way for users to try out new concepts and build prototypes with the STM32 microcontroller, choosing from the various combinations of performance, power consumption and features. The ST connector which is an extension of Arduino Uno provides access to more peripherals to expand the functionality of the Nucleo open development platform with a wide choice of specialized shields. This board does not require any separate probe as it integrates the ST-LINK/V2-1 debugger/programmer and it comes with the STM32 comprehensive software HAL library, together with various packaged software examples as well as direct access to the ARM mdeb online resource. It is supported by wide choice of integrated development environments (IDEs) including IAR, Kiel, ARM mbed and GCC-based IDEs. STM32 Nucleo development boards provide an affordable and flexible way for users to test solutions and build prototypes with any STM32 microcontroller line. The Arduino connectivity support and ST morph connectors make it easy to expand the

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functionality of the STM32 Nucleo open development platform with a wide range of specialized expansion boards to choose from. The STM32 board does not require separate probes as it integrates the ST-LINK/V2-1 debugger/programmer.

# Specifications:

- STM32 microcontroller in LQFP144 package, flexible board power supply, 5V from ST-LINK/V2-1 USB VBUS
- $\circ~$  External power sources of 3.3V & 7V-12V on ST.
- USB OTG or full speed device with Micro-AB connector (depending on STM32 support)
- IEEE-802.3-2002 compliant Ethernet connector (depending on STM32 support)
- o 3 user LEDs, 2 push buttons, USER and RESET
- 32.768KHz LSE crystal oscillator, 216 MHz max CPU frequency
- VDD from 1.7 V to 3.6 V
- o 512 KB SRAM, 2 MB Flash
- GPIOs (114) with external interrupt capability
- o 12-bit ADCs with 24 channels, 12-bit DAC channels
- I2C, SPI, USART/UART
- o General Purpose Timers (10), Advanced-control Timers , Basic Timers, Watchdog Timer



2] BLE: BLE module BT680 Series modules use TC35680 Series SoCs. With an u.FL connector for external antenna, FCC, and other certifications, it allows faster time to market with reduced development cost. Ultra Long Bluetooth Range With a high performance antenna, +8 dBm TX power and CODED-PHY to improve receiver sensitivity, Bluetooth range for 125 Kbps data rate between 2 modules is measured at 3000 meters. Bluetooth range for 1Mbps data rate is 750 meters.

# Table 1. BLE Specification

Bluetooth version	5
SOC	TC35680FSG-002
MCU	Cortex M0 at 32 MHz
Memory RAM/ROM/Flash	240KB/144KB/128KB
HCL Commands	Yes
Standalone mode	Yes
Antenna	u.FL for external antenna
Operational temperature	-40oC to +85Oc
Evaluation Board	EV-BT680E
Price at 1K pcs	\$4.25

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3] RS485: RS485 is a serial data transmission standard widely used in industrial implementations. The Modbus protocol is commonly used when implementing RS485 communication. This differentiates RS485 from the RS232 protocol which communicates by transmitting with ASCII characters. One of the reasons that RS485 interfacing is employed in industrial settings is its ability to serve several devices attached to the same bus. This eliminates the need to have several interfaces available when querying multiple devices. You can do this by using a bus terminator, moving a switch or with a small resistor screwed onto a terminal. RS-485 allows multiple devices (up to 32) to communicate at half-duplex on a single pair of wires, plus a ground wire (more on that later), at distances up to 1200 meters (4000 feet). "Four-wire" networks have one master port with the transmitter connected to each of the "slave" receivers on one twisted pair.

4] Power Over Ethernet: As the name suggests, providing electric power through Ethernet cables is called Poe. We all know that Ethernet cables are used for data transfer and network connectivity but you know that most of the time we do not use all the connecting lines present in Ethernet. Cable For example, consider the Ethernet cable shown in the figure below, it has 8 lines but only four of them are commonly used for data exchange (orange, orange-white, green and green-white) the remaining four lines remain constant. So it is possible to exchange data even after we remove these passive lines at both ends, so low-end Ethernet cables have only four lines instead of eight. So idle four lines can be used for power transfer.



### Benefits Of Poe

Any device which connects to a network via an Ethernet cable – VoIP telephones, wireless routers, IP security cameras – needs only one cable connection to power and operate if you use Poe. This makes installation simpler and less expensive, which helps when it comes to scaling up networks by adding new connections and devices. Poe connections also offer greater flexibility in terms of where you can locate a device, as you are not dependent on mains plug sockets or other power sources. This also offers benefits in terms of reliability and safety – power comes from a single, stable source, rather than a variety of different adapters in different sockets. There is therefore less risk of power outages, overload and potential damage to equipment.



- It will help to control nearby appliances with the help of BLE technology.
- This can be used in industries to operate many machines simultaneously by sitting at one place.
- No requirement of any internet connection to operate appliances.
- It can also be used in real time monitoring system.
- Social alert
- Health and fitness

# V. CONCLUSION

Thus the article explains the design and practical consequences of blades on industrial gateways that collect data from blade devices and transfer data to Modbus RTU and Ethernet for remote monitoring, most industries require solutions for low network traffic and data monitoring of at least several devices with less network traffic and minimal wiring. Old traditional techniques were replaced by electronically controlled machines but they needed lot of wires to control motors basic functionality so this became tedious task. The system is very much helpful for interacting and communicating with humans and other devices. Now internet and wireless communication has been introduced, everything can be controlled wirelessly. This saves you a lot of time and allows you to do more in the same amount of time. In specific cases, you will need fewer people with the help of a remote control, which will positively benefit your cash flow. The safety is a core issue.

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