

IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 4 ISSUE : 06 Print / Issue Publication Date: 06-Dec-2019

ISSN : 2455-2143

DOI : 10.33564/IJEAST.2019.v04i06.016

Indexed In

Google SCHOLAR OPEN ACCESS doi Crossref

WWW.IJEAST.COM

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International Journal of Engineering Applied Sciences and Technology, 2019
Vol. 4, Issue 6, ISSN No. 2455-2143, Pages 104-107
Published Online October 2019 in IJEAST (http://www.ijeast.com)

IOT GATEWAY DESIGN AND IMPLEMENTATION FOR MODBUS PROTOCOL

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***Abstract*— Day-by-day, industries are looking for digitizing their manufacturing process, as well as introducing control and monitoring system along the shop floor. Internet Functionality and data based service have been introduced on process in order to innovate the production based on the industry 4.0 paradigm. In this project we are designing an IoTgateway for ModBus Protocol to collect various data from CNC machine and sending this data to MQTT cloud with the help of ESP32 which is wi-fi module. The proposed aims to show the application of this technology in the manufacturing environment, where IoT linked to system integration and cloud architecture, present the benefit of the industry 4.0 concept. Finally, the gain in productivity and innovation obtained with the concept of advanced manufacturing have been presented to add value in term of growth and competitiveness for the companies in their manufacturing process.**

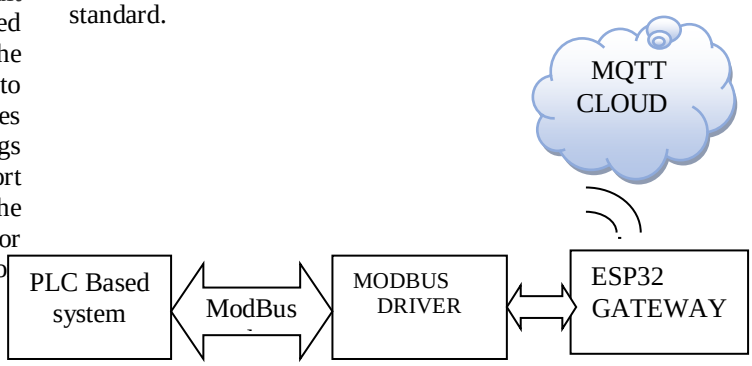
Keywords— **ESP32, MAXRS485, PLC based system**

I. INTRODUCTION

Power plant control of the embedded data acquisition system had been developed from centralized control, Distributed control into field bus control. The paper puts forward a design scheme of the system and the content of Modbus Communication Protocol are introduced while the circuit interface of RS485 is given. This functionality is implemented on a scalable software which connects to the devices in the network and acts as gateway for cloud-based hardware to access devices in the local area network. This paper describes the design and implementation of such an Internet of Things (IoT) gateway for a cloud-based system that requires support for Modbus and MQTT. This platform for implementing the proposed IoT gateway which utilized the MQTT protocol for data transmission. How to organize the data transmissio through the Modbus RTU is explained. The data from PLC and CNC machine will transmitted on cloud through ModBus (RS485) using Wi-Fi module (esp32). The universe of IoT devices is constantly expanding. Gartner Research [1], estimates that around 11.19 billion IoT devices will be connected to the Internet in 2018, that will be more than 33.6% than 2017 and 75.45% more than 2016.This trend will continue arriving at 20.41 billion in 2020.The cloud enables anyone with an internet connection to access IT resources on-demand, such as those consumed by cloud-based applications. The basic resources available are compute, storage, and networking, all of which are needed for a business critical application to deliver a full experience.

II. PROPOSED SYSTEM

The prototype of proposed system can be implemented using ModBus Protocol and ESP32.The proposed system block diagram is shown in the Fig. 1. The PLC receives Information from connected input devices, processes the data and triggers the data based on pre-programmed parameters. A computer converts the design produce by computer aided design software (CAD) into numbers. ModBus is a method used for transmitting information over serial line between Electronics Devices. A computer converts the design produce by computer aided design software (CAD) into numbers. The MAX485 is low power transceivers for RS-485 acts as a ModBus Driver (TTL Converter). RS-485 is just a physical interface standard.



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Fig. 1. Block Diagram of proposed system

The cloud is not a physical entity, but instead is a vast network of remote servers around the globe. Cloud describes a global network of servers, these servers are designed to either store and manage data, run applications or deliver content or a service such as streaming videos, web mail, office productivity software or social media. Instead of accessing files and data from a local or personal computer, you are accessing them online from any Internet-capable device.

III. BLOCK DIAGRAM EXPLANATION

As the aim is to presenting the implementation of a functional model of IoT gateway. The Gateway aims at extending the connectivity of Modbus devices networks to IoT by performing local data processing. Data is taken from PLC based system is given to Cloud through Modbus Protocol. The Modbus protocol is one of the oldest communication standards, use in PLC (programmable logic computers) communication. Communication between devices is done using serial lines (RS232 or RS485) and has a master-slave architecture. The network may include only one Master device and up to 247 Slave devices. The Master device has the ability to write information on Slave devices.

PLC: PLC is a digital computer designed for multiple input and output arrangements, extended temperature ranges, immunity to electrical noise and resistance to vibration and impact.

CNC: Computer Numerical Control. A computer converts the design produce by computer aided design software (CAD) into numbers.

MODBUS: ModBus is a way for electronic industrial devices communicate with each other. It allows information, to be transmitted over serial lines between electronic devices. Devices can request information, as well as supply it.

Types of MODBUS

- ModBus RTU (RS485, RS232, RS422)
- ModBus TCP/IP (Ethernet)
- ModBus ASCII

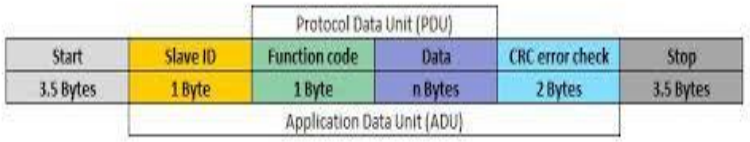
MODBUS RTU (RS485) :-

RS485 is serial communication protocol which uses differential signals to transmit binary data. It uses positive and negative 5V to create differential voltage.

• It supports higher data rate with higher distance compare to RS232 protocol. Distance of maximum 1200 meters (about 4000 ft.) can be supported by RS485 interface.

• Unlike one to one communication between driver and receiver, RS485 supports multiple receivers with single Driver.

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Modbus RTU Frame

ESP32:

The ESP32 is a low-cost system-on-chip (SoC) series created by Express if Systems. It is an improvement on the popular ESP8266 that is widely used in IoT projects.

The ESP32 has both Wi-Fi and Bluetooth capabilities, which make it an all-rounded chip for the development of IoT projects and embedded systems in general. The ESP32 is the ESP8266 successor. It adds an extra CPU core, faster Wi-Fi, more GPIOs, and supports Bluetooth 4.2 and Bluetooth low energy. Additionally, the ESP32 comes with touch sensitive pins that can be used to wake up the ESP32 from deep sleep, a built in Hall Effect sensor and a built-in temperature sensor.

CLOUD:

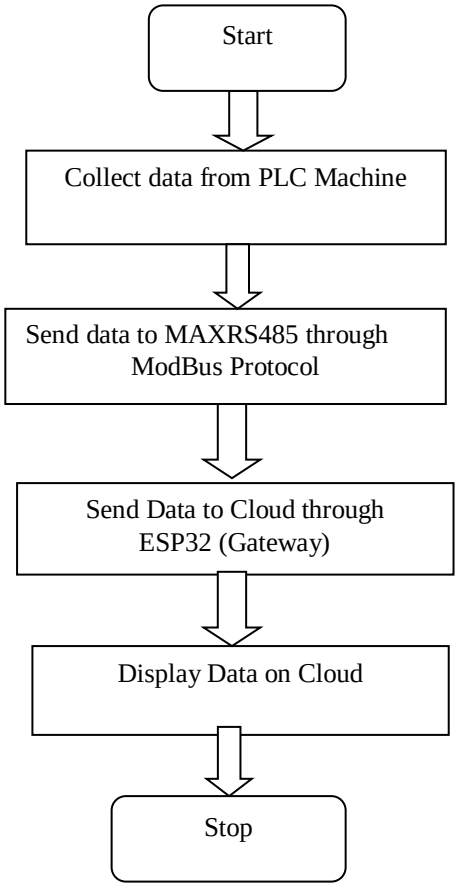
The cloud is a huge, interconnected network of powerful servers that performs services for businesses and for people. Cloud computing, often called simply "the cloud," involves delivering data, applications, photos, videos, and more over the Internet to data centers. Hybrid Cloud: Takesthe foundation of a private cloud but provides public cloud access. PLC device should be able to:

- send/receive data to/from AWS IoT
- use a standardized transport

IV. SYSTEM FLOW DIAGRAM

The software flow for the given system is given in three approaches as data collection, data Transmission and display of data.

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V. EXPERIMENT AND RESULT

We have successfully transmitted Data collected from PLC based System on cloud with the help of ModBus Protocol using IoT gateway.

VI. CONCLUSION

The system discussed in this paper is beneficial to the Industrial Applications involves Monitoring, Management and Control etc. A mode of operation of this System is very simple. The Human Intervention can be reduced by the use of this system and also we can achieve efficient transmission of Data on Cloud. It also reduces lot of laborers cost. It is very helpful for all Industrial applications.

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ABOUT IJEAST

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