Autonomous Smart Energy Meter over Internet of Things using Raspberry Pi

Manogna Pamulaparthy¹, K. Jeevana Jyothi²

¹PG Scholar, Department of ECE, Siddhartha Institute of Technology and Sciences, Hyderabad, Telangana, India
²Assistant Professor, Department of ECE, Siddhartha Institute of Technology and Sciences, Hyderabad, Telangana, India

Abstract. The industrial sensor monitoring is very important for employee security. Now a day's technology enhances the security system to next level. Internet of things provides the security information known by anywhere in the world. In the proposed article we monitor the industrial security parameters and alerting system to prevent the over damage in case of emergency. Proposed system uses temperature, humidity, smoke, fire sensors for security monitoring and data will process by raspberry micro processor. All the sensor data will post into server for wireless security monitoring with the help of ESP8266 which is built in raspberry pi processor. Buzzer module used to alert the employee at industry for security. This proposed article will enhance the employee security and necked eye monitoring about the emergency in industrial.

Keywords: Energy Meter, Current Sensor, IOT, Raspberry Pi, Relay, LCD.

1. Introduction

Internet of Things (IoT) is a computer term that describes an all-encompassing Internet service that transforms ordinary objects into network devices. The basic premise behind all the IoT principle is to introduce billions or even trillions of intelligent devices able to perceive the surrounding area. By 2021, about 28 billion wireless modems are expected to be available. The relation of new artifacts to the Web enhances business and society's prosperity, health and the productive contact between the physical world and the interactive equivalent. IoT is generally portrayed as a disruptive innovation to address most contemporary social challenges such as digital communities, smart infrastructure, control of emissions and associated welfare. Using wireless connections usually addresses the flexibility and scalability desired by IoT communication systems. Wireless modems have in the past been based mainly on ad hoc approaches in industrial purposes, e.g. independently designed for the communication of shifting components or difficult to access tools. Just recently, industry-specific guidelines have been published nevertheless, when large areas are shielded, they encounter weaknesses in scalability and distribution. The fulfillment with the above specifications faces many great challenges in the growth of Industrial IoT (IIoT). Acknowledging these issues is key to ensuring that IIoT solutions are widely implemented. Throughout this article, we elucidate the theories of IoT, IIoT as well as the recent trend in manufacturing technology computerization and data transfer, called Industry 4.0. We emphasize the possibilities and challenges presented by IIoT for its implementation.

We concentrate in detail on the problems of energy consumption, real-time results, coexistence, interoperability, data security. Smart Industry Surveillance is being used to supervise the climatic conditions of the machinery in the company, because if a sudden shift occurs in the machinery, if the chemical temperature of the device is above the desired temperature, if we cannot detect that the changes occur if the temperature in the industry is kept, then the chemical can overflow. The Internet of Things (IoT) has given enticing opportunities by exploiting the increasing all-embracing broadcast-frequency identification (RFID) and wireless, mobile and sensors systems to build strong industries and implementations. Throughout recent times, a wide array of industrial IoT technologies have also been built and tested. The paper discusses the existing research of IoT, core supporting technology and significant IoT implementations for business, and describes market developments and barriers to recognize the advancement of IoT in industries. One significant contribution of this review paper is that it thoroughly discusses industry leading IoT
developments. In existing system of Industrial sensor monitoring system all the temperature, humidity, pollution sensors monitor the data and display in LCD module. There is no automation. Only the manual mode of operation is going and it is very difficult to operate. No wireless technology used to transfer the data automatically alerts through buzzer. Due to no wireless data transmission it’s very dangerous in industrial application. So we proposed new system using IOT for easy access and alert the data.

2. Literature Survey

The system aims at designing and implementing a model that enables the end user to obtain their electrical unit consumption without any human intervention. The model senses the blinking of LED on the energy meter [1]. Once a threshold set to 25 blinks of LED, 10 watts of power consumption is transmitted on to the LCD of transmitter and receiver through LoRa. The author introduces a system that provides a solution to reduce the cyber-attack risks in metering system which may result in leakage of user privacy [2]. A key management protocol is designed to update the keys periodically so that there is a long-term security of metering system. The research aims at collecting the meter readings from the smart meters and transmitting these readings back to SAS (Substation Automation System) as per the predefined scheme. The broadcasting is secured by pair wise secret key between the SAS and smart meter. The integrity of the new key is verified if it is equal to the current key efficiently through the device. The performance of the system is evaluated by measuring the inquiry time of the active energy which is used for billing. The deployment expectation and preference of smart phones and its applications as an interface of a human computer to the smart meter has been analyzed [4]. In order to simulate the interest in energy efficiency and smart metering subjects, smart metering application could be used. The electricity consumption is constantly monitored by the smart meter. The consumption analysis of the data can be presented at any point of time. The user can have an incentive to save energy and money due to the provision of dynamic tariffs. A prototype for such smart metering application is defined using user central design approach. In this paper GSM technology is used to modernize the billing system [5]. The optocoupler used by the energy meter generates pure signal based on the amount of load consumed by the user. The op-Amp which gives the fixed output acts as an error amplifier that can be regulated using LM7805. Hence by giving an alert which indicates the information about the number of units consumed by the load, the electricity consumption can be minimized. In this paper a two-way smart meter implementation approach is used which will be evaluated and analyzed using Techno-economic approach and is implemented using LoRaWAN in PLN Bali [6].

3. Proposed System

Fig.1.Block diagram

We use Raspberry Pi software to code our smart meter with the required operations to be performed
and to interface our program to the Raspberry Pi. So the calculated information or the current and voltage consumption will be displayed on the LCD also on the IOT app. Now we explain about the receiver part. We need another Raspberry Pi and power supply here for its functioning. We need Wi-Fi to access the information on Transmitter from the user side so the consumption of current and voltage which is displayed to us will be displayed to the suppliers also in the LCD. This is possible because we are using IOT app and it acts as cloud.

This schematic diagram informs that which module of the pins connected to which pins of microprocessor Raspberry pi.

A. Regulated Power Supply

In this section of RPS we need 5v dc to work RPI processor. This RPS module is getting the required voltages from higher voltages with the help of filters and voltage regulators. 12v alternating current received by 230 v alternating current step-down by transformer, Bridge rectifier used to converts AC voltage to DC voltage. 1000 micro farad Capacitor for filtering the noise and voltage regulator 7805 used to provide 5v DC for operating the RPI processor.
B. Raspberry Pi

Raspberry pi processor used to integrate the all input and output peripherals, process the input data and control the output modules. This processor having 4 USB ports for integrating output modules. 1GB RAM which is high speed process the data. 3.5mm audio socket for output voice, CSI camera port for interface camera, micro SD card for operating system storage, 1.2GHz speed 64 bit Broadcom processor. This processor having 40 GPIO pins. All input sensors and output modules are interfaced to processor. Python programming used to implement RPI based applications.

Fig.4. Raspberry Pi

C. Energy Meter

Energy meter is used to measure the consumption of energy from the user. Current sensor used for measuring of the current along with that voltage is multiplied power will be calculated in this meter. This energy meter is low power isolation protected device. This isolation device protect from short circuit. Depends upon the data consumed by load it will give the data to raspberry pi processor that will post the data into iot server.

Fig.5. Energy Meter

A. LCD Monitor

A liquid Crystal Display commonly abbreviated as LCD is essentially a display unit built using liquid technology. LCD module is 32 character displays, which is 16x2 models. Having 16 characters in row. LCD module interfaced to microprocessor with 16 pin configuration. LCD has 16 pins in series. Each pin is programmed to do here: Pins 1 and 16: Power and ground are these. Pin 3: This is used to change the LCD's brightness. Pins 4–6: Used for LCD service. Pins 7–14: Used as line of info. Pins 15–16: Used to control backlight to the LCD.

Fig.6. 16X2 LCD
B. IOT- Module

ESP 8266 Module used for Internet of things operations. Internet of things is the latest technology for controlling and monitoring operations through the world fast and secure. Wireless fidelity based operating module which works with 5GHz frequency. It supports 802.11b, 802.11n wireless transmission of data protocols. Normally we use 4 pins in this 3.3v voltage, ground comes under power supply for operating device, TX,RX are transmit and receive the data from micro processor bidirectional.

![ESP 8266 module](image1)

Fig.7. ESP 8266

C. Buzzer

Peizo electric buzzer is used for intimating the changes in this system. Buzzer is the output module used to generate alarm. This module which converts the voltage to sound signal. We directly connected to RPI processor for inform.

![Buzzer](image2)

Fig.8. Buzzer

D. Software

In embedded system software module plays important role for any electronic automation. This proposed article we use Python IDE for programming development, debugging and compilation process. Python is effective scripting language for real time applications. Rasberian Operating System is used in Raspberry pi modules.
E. Results And Discussion

Hardware setup of energy meter. Input module energy meter along with current sensor is integrated to Raspberry Pi processor, it monitor the data and if exceeds the data it displays data on LCD.

Fig.9. Output Hardware setup

In the receiver part, firstly it checks for the Wi-Fi connection if this condition is true, it will verify and take authentication. Then it connects to cloud. After it connects to the cloud it obtains the values from transmitter and displays it in to the LCD.

Fig.10. Electrical parameter Voltage

4. CONCLUSION

We designed and implemented smart energy meter for prepaid energy consumption utilization. In this proposed model we integrated all input module energy meter to raspberry pi processor and output module like load with the help of relay, internet of things module, lcd, buzzer integrated. After presetting of energy consumption is over then automatically load will off and send the data to iot module for alerts. This is much customized module, with low power consumption.
References

[1] D. Sharayu, and H, Dhanawade, “Smart Electricity Meter using LoRa Module”, 4th International Journal of Advanced Research, Ideas and Innovations in Technology, vol. 5, no. 4, (2019), pp. 146-148.
[2] C. Yao, H. Saputra, L. Meng Goh, and Y. Wu, “Secure Smart Metering Based on LoRa Technology”, 4th International Conference on Identity, Security, and Behavior Analysis (ISBA): Singapore, Proceedings 1-8, Research Collection School of Information Systems, (2018).
[3] F. Abate, M. Carratu, C. Liguori, and M. Ferro, “Smart Meter for IoT,” International Instrumentation and Measurement Technology Conference(I2MTC), Houston, TX, USA, IEEE, (2018).
[4] B. Stephan, and L. Szwec, “Smart Meter with Smartphones: User – Centered Design of a Mobile Application in the Context of Energy Efficiency”, International Conference of Design, User Experience, and Usability, (2013), pp. 631 – 640.
[5] P. Loganthurai, M. Shalini, A. Vanmathi, M. Veeralakshmi, and V. Vivitha, “Smart Energy Meter Billing using GSM with Warning System”, International Conference on Intelligent Technologies in Control, Optimization and Signal processing (INCOS), Srivilliputhur, (2017).
[6] W. Gunawan, G. Permata Sakti, and I. Ibrahim, “Techno economic analysis of smart meter reading implementation in PLN Bali using LoRa Technology”, International Conference on Broadband Communication, Wireless Sensors and Powering (BCWSP), Jakarta, Indonesia, (2017).
[7] V. Nadege, and J. Schwoerer, “Capacity Limits of LoRaWAN Technology for Smart Metering Application”, International Conference on Communication (ICC), Paris, France, (2017).
[8] C. Fabio, D. Gallo, C. Landi, M. Luiso and R. Rinaldi, “Smart meter system for smart grid management”, Department of Industrial and Information Engineering Second University of Naples, Aversa (CE)- (2016).