AUTOMATIC ENERGY AND CARBON EMISSIONS MONITORING SYSTEM USING OPC ARCHITECTURE

Mohd Faiz Rohani, Noor Azurati Ahmad@Salleh, Suriayati Chuprat and Shamsul Sahibuddin

INTRODUCTION / OBJECTIVE

INTRODUCTION

Global warming and climate change is being an issue for more than a decade. It has given the negative impact to the nature, such as rise of global temperature, unpredictable weather and many other natural disasters. Human activities that are resulting in emissions of Greenhouse Gases (GHG) contribute to these problems. These gases will trap heat into the atmosphere that cause the rising of earth temperature.

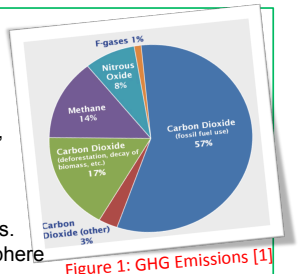

Figure 1: GHG Emissions [1]

Based on IPCC report in 2007 (as shown in Figure 1), Carbon Dioxide (CO_2) is the main contributor to GHG emissions which are closely related to natural and human activities [1].

MOTIVATION

Industrial and Energy sectors contribute to massive GHG emission sources [1]. This is due to the increament of industrial activities and energy demands of the sector and dependency on fossil fuel for electricity generation. Malaysian total CO2 emissions come from energy consumption has increased dramatically for the past decade as can be seen in Figure 2.

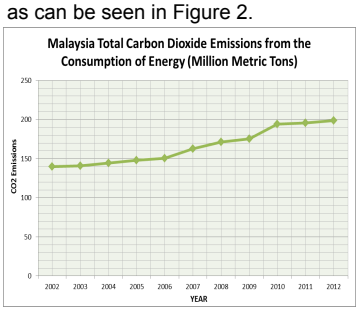

Figure 2: CO2 Emissions from Energy Consumptions [2]

Hence, monitoring and measuring of energy consumption and release of GHG emissions are important to ensure that the data of carbon emissions are monitored closely. The data can be analysed to find the root cause and historical trending of emissions, thus facilitates the decision making in controlling the GHG parameters [5].

RESEARCH OBJECTIVE

The aim of the project is to find ways to minimize effort in monitoring carbon emissions. An automatic carbon real-time monitoring system will be developed in this research enable to monitor carbon emissions released at any particular area or process and energy consumption which equivalent to carbon emissions calculation. Integration with the existing industrial system through Object Linking and Embedding for Process Control (OPC) protocol to support data interchange between the carbon monitoring system and industrial SCADA/HMI possible [4].

RESEARCH METHODOLOGY

Methodology of this project can be presented as below:

- Study of CO2 emissions and energy consumption in industrial sector, find research gap and solution
- Study system characterization, hardware and software selection
- Hardware configuration and software programming
- Integrating OPC server for data connectivity
- Integration with industrial SCADA/HMI, database & interface design
- System testing and evaluation

RESULTS AND DISCUSSIONS

WHAT IS OPC?

OPC is the interoperability standard for secure and reliable exchange of data for industrial control systems. Single protocol implementation for interfacing from process control devices to higher level application as shown in Figure 3, eliminate of multiple drivers needs for communication [4].

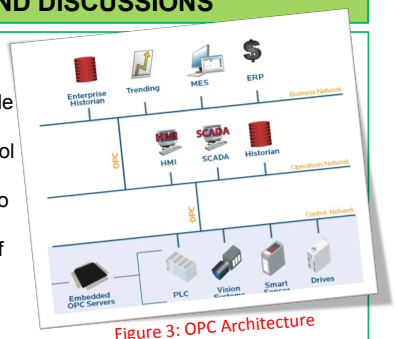

Figure 3: OPC Architecture

DESIGN CONSIDERATIONS

The design of an automatic energy and carbon emission monitoring system is shown in Table 1.

Table 1: Project Design Considerations

Design	Justification
Microcontroller	• Low cost, low power, adequate I/O and processing power system : Arduino Families
Wireless Unit	• Low cost, low power, durability and immunity to noise : ZigBee
Sensing & Measurement Unit	• Low power, high accuracy, long term stability in harsh industrial environment : Non Dispersed Infra Red (NDIR) CO2 Sensor [6], Digital type Power Meter
Software & Database	• Industrial standard protocol for device and system integration: OPC/ SQL Server

PROPOSED ARCHITECTURE

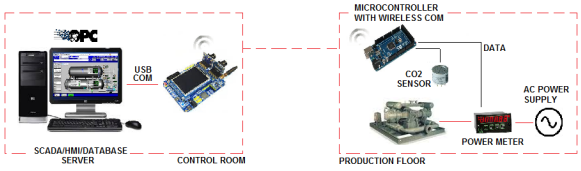

Figure 4: Proposed System Architecture Diagram

Our proposed monitoring system is shown in Figure 4. A sensing unit will be interfaced to a microcontroller for data collection, calculation of carbon emission and sending data to a receiver unit. Inputs will be collected from 2 main sensors; i) CO2 NDIR sensor with built in temperature sensor and; ii) power meter serial data input to read power consumption of machineries and industrial system.

On the Receiver/Coordinator unit, a microcontroller will be setup with a ZigBee receiver. The data received will be mapped to OPC protocol by the microcontroller OPC DA Server. The mapped tags (data) can be easily accessible by any OPC Compliant application such as SCADA/HMI or third party OPC Clients.

REFERENCES

[1] International Panel of Climate Change (IPCC) - http://www.ipcc.ch/
[2] Energy Information Administration - http:// www.eia.gov/ environment/
[3 Suruhanjaya Tenaga Malaysia http://www.st.gov.my/index.php/
[4] OPC Foundation - https://opcfoundation.org/
[5] Abdullah, et. all "Development of wireless sensor network for monitoring global warming," *(ICACSIS), 2012 International Conference* Dec. 2012
[6] Garcia et .all ,"An electronic interface for measuring CO2 emissions in embedded systems," *(I2MTC), 2012 IEEE International* , May 2012

ACKNOWLEDGEMENT / CONTACT DETAILS

This research is part of MSc Computer System Engineering's final year project in Advanced Informatics School (AIS). This work has been supported by the Encouragement Grant, VOTE No.(11K37). Hence, the authors would like to thank the Ministry of Education (MoE) Malaysia and Universiti Teknologi Malaysia (UTM) for their support.

Contact details: azurati@utm.my, Advanced Informatics School, UTM Kuala Lumpur