NOISE POLLUIION MONITORING

ABSTRACT

Modernization has brought the world technological advancements, but it has also brought with it a slew of problems. In today's Malaysia, air and noise pollution are becoming more of a concern, along with a rise in occupational disease. A monitoring system is needed to address these issues. This paper describes the development of a real-time IoT-based air and noise pollution monitoring system that can provide monitoring and alert the user to the pollution levels. This monitoring system was built using IoT technology, which included the use of an ESP8266 Wi-Fi Module NodeMCU as a microcontroller to communicate with the chosen IoT analytics platform, ThingSpeak. A gas sensor MQ9 was used to measure carbon monoxide concentrations, and a sound sensor LM393 was used to measure noise levels in the surrounding area. The measured values were displayed on the Arduino software's serial monitor, then sent to the ThingSpeak server and graphically displayed in real time on a screen. The results of the electronic sensors were compared to the results of the stand-alone carbon monoxide meter and digital sound level meter for validation. The proposed monitoring system produced promising results, with 91.12 % and 97.86 % accuracy for gas and sound levels shown by the gas sensor MQ9 and sound sensor LM393, respectively. The framework also provides ThingSpeak server warning messages. When the calculated conditions exceeded the user's defined cap, the server sent the user an email update with the gas and noise limit status. This has made the system more useful and convenient

INTRODUCTION

Malaysia's industrial growth has accelerated in recent years. This raises pollution levels, especially in industrial areas. Major industries affecting the air quality are the iron and steel industry, nonferrous metal industry, non-metallic

(mineral) industry, oil and gas industry, petrochemical industry, pulp and paper, power plant, and waste incineration sector [1]. Each of the pollutant has different trait. For instance, Particulate matter (PM) can cause lung cancer and cardiopulmonary deaths while ozone (O3) can reduce lung cancer function and induce coughing and choking [2]. Carbon monoxide (CO) can cause mortal growth in pregnant women as well as affect tissue development of young children [2]. The concentration of carbon monoxide and the duration of exposure will determine the probability of health risk. The toxic effects range from subtle cardiovascular and neurobehavioral effects at low concentrations to unconsciousness and death after prolonged exposures to high concentrations of carbon monoxide [3]. A non-irritating gas such as nitric oxide (NO) may irritate respiratory infections with symptoms such as cough, sore throat, nasal congestion, and fever while sulfur dioxide (SO2) can cause shortness of breath in people with asthma [4]. According to the Ministry of Health Malaysia (MoH), respiratory system diseases were one of the leading causes of hospitalization in MoH hospitals in 2011, accounting for 10.36% of all hospitalizations (MoH, 2012) [5]. Noise-induced hearing loss (NIHL), in addition to respiratory disease, is also one of public health issues [9]. It is, however, regarded as the most preventable cause of hearing loss in the workplace [6]. Every year, the number of occupational diseases in the heavy machine industry rises. In Malaysia, based on the industrial noise control module, cases regarding occupational noise related Hearing Disorders (HD) increased from 2876 cases in 2016 to 4787 cases in 2017 [7]. Machinery, manufacturing, and automobiles are the three most harmful causes of noise emissions in an industrial environment [4]. Excessive noise causes low performance and absenteeism among workers, as well as a loss of productivity due to hearing loss [9]. It also induces sleep disorders and a variety of health problems, including hypertension and human psychosis. An individual can tolerate 90 decibels (dB) of noise for 8 hours, 115 dB for a short time, and noise levels higher than that are not recommended [7]. According to other research, peak sound levels of 85dB to 90dB can cause hearing loss [9]. While many systems exist to track air pollution levels and detect toxic gases, many businesses need a real-time IoT monitoring device. The smart city model, which is rapidly becoming the benchmark for both developing and developed countries [10], includes air quality monitoring and control. The IoT-based industrial plant safety gas leakage detection system is an existing air pollution monitoring system equipped with a IoT system specially designed to detect gas leakages in power plant sites to avoid pollution, explosions and maintain the safety of employees. The proposed leakage detector is able to detect various types of gases and immediately alert workers via Short Message Service (SMS) notifications. Despite its simplicity, the centralized warning protocol may be ideal for alerting powerplant personnel in circumstances where cell phones are not permitted. Indoor air quality system is an IoT system that is innovatively integrated into the use of Raspberry Pi, Fuzzy logic, and Cloud Server applications [12]. This system can detect carbon dioxide gas and particulate matter (PM10) [12]. Message Queuing Telemetry Transport (MQTT) is the main con of this system as it only functions in a low bandwidth device. K. Gayathri proposed a device has high sensitivity towards more gases such as ammonia, sulphide, and benzene steam in a study [13]. At the same time, the device will determine the air quality index and noise levels. These systems, including the indoor air quality system, use Message Queuing Telemetry Transport (MQTT) to monitor outputs and send messages [13], which is the con of this system. Another system provides additional features such as air, sound, temperature, and humidity monitoring [14]. The inputs of this system are from the MQ135 and MQ7 gas sensors, sound sensor module mic, andDHT11 temperature humidity sensor. This system can detect hazardous gas and display pollution levels on an LCD display monitor. It is not, unfortunately, designed for wireless centralized monitoring [1]. The proposed framework in this paper, on the other hand, integrates gas and noise pollution measurement and provides centralized monitoring from a website, as well as the ability to warn the user when pollution levels reach alarming levels. This will ultimately provide impetus to address the pollution problem in heavy industry while still ensuring that pollution levels remain within safe limits

REQUIREMENT

INPUT

Sound sensor LM393 gas sensor MQ9

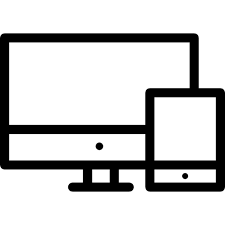
CONTROL

ESP266 WI-FI WI-FI CONNECTION

MODULE NODEMCU

OUT PUT

user pc

METHODOLOGY

The proposed IoT Based Air and Noise Pollution monitoring system block diagram is presented in Figure 1. A NodeMCU ESP8266 Wi-Fi module is used as the main microcontroller as it can connect to the selected IoT server using Wi-Fi connection. Wireless communication between ESP8266 Wi-Fi Module NodeMCU and ThingSpeak was enabled. ThingSpeak was the cloud system used to analyze and store air quality and noise level data. In this proposed system, hotspot mode was used to connect ESP8266 to the internet. A mobile phone was used as a hotspot to make it easier for ESP8266 to connect to the Internet without installing a separate wireless router. A NodeMCU board is used as it offered a simpler and direct conversion from analog to digital. Gas sensor MQ9 was used to measure carbon monoxide concentrations and a sound sensor LM393 was used to measure noise levels in the surrounding area. Gas sensor MQ9 has a range of detection of 10-1000 ppm for Carbon Monoxide gas and 100-10000 ppm for combustible gas. Figure 2 shows the hardware setup when measuring the carbon monoxide concentration and noise level using the MQ9 gas sensor and LM393 sound sensor. Figure 3 (a) shows the Benetech carbon monoxide meterand the (b) SMART SENSOR Intell Instruments Pro digital sound level meter. Both are stand-alone measuring devices used to measure carbon monoxide concentration and noise levels for validation purpose. The Benetech carbon monoxide meter used to measure carbon monoxide concentrations has a measuring range from 0 – 1000 ppm carbon monoxide and a basic error rate of ±5 to ±10 ppm. A digital sound level meter manufactured by SMART SENSOR Intell Instruments Pro used to measure the noise level in the surrounding area has a basic error rate of ±1.5 dB and is able to measure noises ranging from 30 dB – 130 dB. The values obtained from both devices were used as true values.