International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-7, Issue-6, March 2019

Chemical Process Parameter Surveillance using Iot

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Abstract*: It is observed that in the recent past many technological revolutions, including the transition from the analog world into its digital counterpart and from centralized wired solutions to distributed and pervasive wireless systems. Industrial Monitoring is essential to collect all the relevant information, data and statistics related to the various industrial processes employed in industry premises, in order to ensure optimal resource consumption and to improve production efficiency. In current scenario most of the industrial parameter monitoring equipments and instruments are wired or wireless. The wired instruments depend on manual operation which is the most upcoming issue in the industrial sectors. If the parameters are not monitored properly, it may lead to a harmful situation. The installation process in wired system is difficult and costly. Similarly, the wireless based smart instruments are facing challenges related to lifetime, data loss and coverage issues. In this project, a new solution is adopted for the traditional monitoring of the chemical process tank parameters in industries through the implementation of Internet of things (IoT) which is rapidly developing technology because today's world is internet world. In this work, the industrial process tank parameters being monitored by NodeMCU. The cost of the controller is less when compared to RF based wireless communicating devices. In this system, the process parameters such as temperature and level are monitored using sensors and accessed through mobile application in remote locations using IoT. Compared to existing wireless instruments the making cost of the proposed system with IoT is lesser with better accuracy.

Index Terms*: Internet of Things (IoT), Microcontroller, Mobile Application, Sensors, Wireless communication

I. INTRODUCTION

Industrial environmental conditions have been upgrading day by day with the newly introduced automatic techniques as a result of getting rid of the conventional procedures of monitoring the industrial parameters. Due to complex design, cost and the system requirements involved in the conventional wired method, an alternative system which provides simpler design, cheap and less system requirements are necessary for monitoring the process parameter from remote location for easy access.

Internet of Things (IoT) is anticipated to modernize the world by enabling us to monitor and control dynamic phenomena in the industrial environment through the use of devices capable of sensing, processing and wirelessly transmitting data to remote storage like cloud which stores, analyzes and presents the data in the useful form. From the cloud this information can be retrieved through various front-end user interfaces such as website or mobile applications, depending upon suitability and necessities. Internet lies at the core of this transformation playing its role in efficient, reliable and rapid communication of data from devices to the cloud and from the cloud to the end users.

Industrial monitoring is an important IoT application which involves monitoring the industrial parameters and broadcasting this data for effective short-term measures in remote location and long-term data analyses. This paper presents the implementation details and results of a chemical process tank monitoring system in industries. This system comprises of a central ESP8266 NodeMCU Wi-fi Devkit board which interfaces at the input with temperature and level monitoring sensors and the output from ESP8266 WiFi module which is inbuilt in NodeMCU transmits the sensed data through internet to remote cloud storage ThingSpeak. DS18B20is used to gather the temperature of the processing fluid inside the chemical tank and HC-SR04 ultrasonic sensor is used to detect the level of the fluid in the tank. A mobile application ThingView is used to retrieve the data from the ThingSpeak cloud for user display from anywhere in the world. This is a low-cost system which gives insight into the design and implementation of a complete IoT application involving all features from sensing and wireless transmission to cloud storage and data retrieval from cloud via a mobile application. This system involves inclusive study and utilization of ESP8266 NodeMCU Wi-fi Devkit board, its interfacing with input modules such as sensors and the usage of ThingSpeak open source API and finally the interfacing of ThingView mobile application with the cloud. The results of the project show the real-time monitoring of temperature and level of fluid inside the chemical tank from any location in the world and its statistical analysis. This system can be extended to enable remote controlling of devices based on sensed data.

Revised Manuscript Received on 30 March 2019.
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II. LITERATURE SURVEY

Since the world is moving towards the wireless systems the industries are also slowly shifting their focus towards the wireless instruments. Numbers of research articles are proving that wireless parameter monitoring and control is possible for the industries. In the work [1], author develops a Wireless Sensor Network (WSN) based system to monitor and control the parameters. Compared to IoT device the cost of designing the WSN is higher and also has drawback of consuming high power compared to IoT device [2]. In the work [3],[4] and [5], authors develops a system to monitor and control the industrial parameters based on IoT devices. To monitor the industrial parameters in the work [6] author combines WSN and IoT based system. This proposed system collects the information through WSN and uploads the final data to the server using IoT. To upload the data to the free cloud Thingspeak API is used by the author in the work [7].

III. PROPOSED SYSTEM

The proposed system consists of a chemical process tank, heater arrangement, temperature sensor and level sensor. The heater is fixed at the bottom of the chemical process tank to heat and maintain the temperature of a processing fluid. To measure the temperature of the processing fluid DS18B20 temperature sensor and to measure the level of a fluid non-contact type HC-SR04 ultrasonic sensor are preferred. The outputs of the sensors are connected to the microcontroller unit NodeMCU. The measured data are transmitted to the cloud wirelessly using NodeMCU. The Figure 1 shows the block diagram of proposed system.

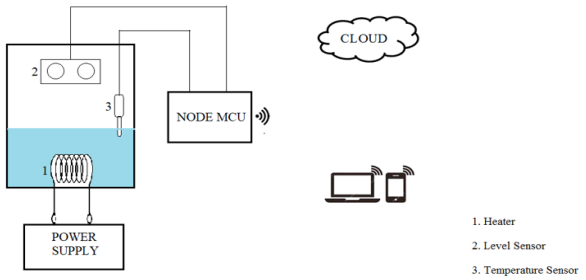

Fig. 1 Proposed system

The stored data from the cloud is retrieved to view it in the app in remote location using IoT technology. This proposed system helps in continuous monitoring over the chemical process tank parameters.

IV. HARDWARE DESCRIPTION

The chief unit is ESP8266 NodeMCU Wi-fi Devkit board that acts as the main processing unit for the entire system, it is interfaced with the sensor modules at the input for receiving temperature and level readings which transmits the received data with the help of Wi-Fi module to the cloud over the Internet. The data's in the ThingSpeak cloud is viewed in ThingView app for analysis.

A.MICROCONTROLLER

Heart of the proposed system is the NodeMCU microcontroller which interfaces with other components of the system and uploads the sensor value to the cloud. This microcontroller board has 17 digital I/O pins, 1 analog input pin and 80~160 MHz quartz crystal. This microcontroller has inbuilt Wi-Fi Module with integrated TCP/IP protocol stack that can give any microcontroller to access the Wi-Fi network. It can be powered with a battery whose operating voltage is 3.3V with operating current between 12-200mA. The figure 2 shows the hardware model of NodeMCU

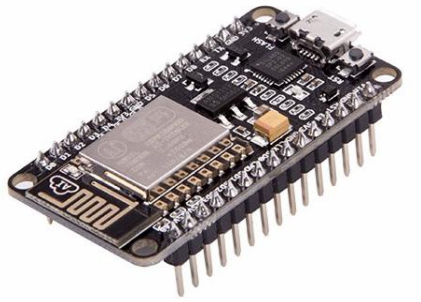

Fig. 2 NodeMCU

B. LEVEL SENSOR

HC-SR04 ultrasonic sensor is used to measure the level of working fluid inside the tank. This module includes ultrasonic transmitters, receiver and control circuit. It transmits an ultrasonic wave at the frequency of 40kHz, this wave gets reflected back to receiver module if any material presents on its path. It offers excellent non-contact range detection with high accuracy and stable readings. It measures in the range between 2 cm to 400 cm. It is a 4-pin sensor, namely Vcc, Trigger, Echo and Ground respectively. The working current of this module is 15mA.

The operating voltage (Vcc) of the sensor is +5V. Trigger pin is an input pin which has to be kept high for 10µs to initialize ultrasonic sensor to send the ultrasonic wave for measurement. Echo pin is an output pin which is connected to microcontroller, this pin goes high for a period of time and this period will be equal to the time taken by the ultrasonic wave to return back to the sensor. Then the ground pin is connected to the ground of the system. The figure 3 shows the hardware model of HC-SR04 ultrasonic sensor.

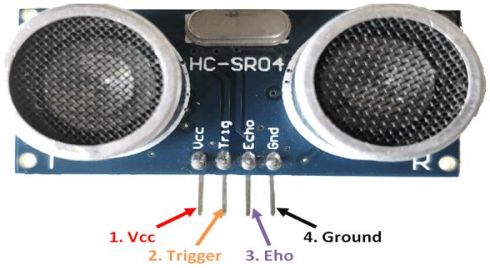

Fig. 3 Ultrasonic sensor

C. TEMPERATURE *SENSOR*

DS18B20 waterproof temperature sensor is used to measure the temperature of water inside the tank. It is a digital thermo probe or sensor that employs DS18B20. Its unique 1-wire interface makes it easy to communicate with microcontroller. It converts the temperature to a 12-bit digital word in 750ms (max). Besides, it can measure temperatures from -55°C to +125°C (-67F to +257F).

In addition, this thermo probe doesn't require any external power supply since it draws power from data line. This sensor probe head is made up of stainless which makes it suitable for any wet or harsh environment. The figure 4 shows the hardware model of DS18B20 temperature sensor.

Fig.4 DS18B20 temperature sensor

V. SOFTWARE IMPLEMENTATION

Software plays a key role in the incorporation and functioning of our hardware design. There are two parts to our software development: initialization and configuration of hardware, and the configuration of Android based mobile application for user interface.

A. SOFTWARE FOR INITIALIZATION AND CONFIGURATION OF HARDWARE AND CLOUD

Arduino IDE was used to program the microcontroller for data retrieval from sensors and data transmission to the cloud. First of all, the Wi-Fi shield was initialized by sending AT commands in the required pattern to make it work as a client. Then it will be configured for Wi-Fi module ESP8266 as a TCP/IP client. Finally, program for reading the data from sensor in real-time is uploaded. Once sensor data is read by the microcontroller and uploaded to the cloud, we use the IoT analytics service of ThingSpeak to aggregate, visualize and analyze live data stream. The Wi-Fi module sends data to the cloud through its assigned IP. Once connected to ThingSpeak, an API key is assigned to observe the results over a channel. Therefore, we wrote the API key before writing the actual data, and then the data was stored and displayed in the appropriate channel.

B. ANDROID APPLICATION

The Android application communicates with the microcontroller through ThingSpeak cloud. Using the REST API request method, channel can be created; to update its feed, update an existing channel, clear a channel feed, and delete a channel. ThingView app receives information from ThingSpeak cloud by using REST API Web Service and channel ID and field number within its parameters. The end users can run the Android application and it allows them to monitor the real-time water level and temperature. The user authentication feature of the application verifies the authorized users through login and password. After authentication, the user views the results in chart form from the cloud.

VI. RESULTS & DISCUSSION

Since the proposed system is battery operated lifetime of the proposed system is to be considered. Earlier in the article it has been indicated that IoT based measurement consumes less power than WSN based measurement. As per the article [2], a sensor node based on LPC2148 system consumes 11.83mWh to acquire 6 sensor values for period of 9 seconds. Whereas the proposed system consumes power of 1.95mWh (Battery Voltage Drop * Battery Current Rating) for every 9 seconds to transmit the data to the server. From this analysis it is clear that the IoT based system consumes lesser power than WSN based system.

The figure 6 shows the hardware arrangement of the proposed system. The figure 7 shows the output viewed in ThingSpeak cloud. The figure 8 shows the output viewed in ThingView mobile application.

Fig. 6 Hardware Setup

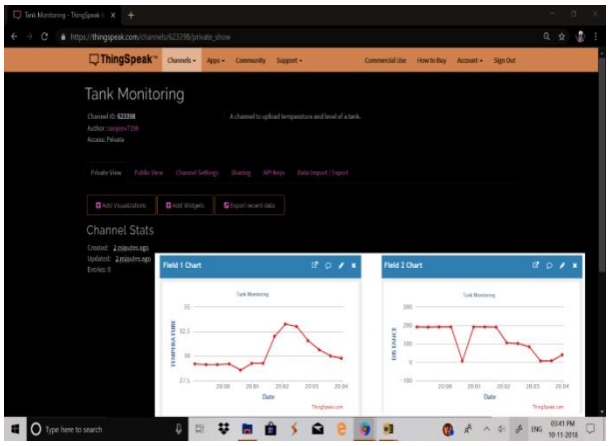

Fig. 7 Data uploaded in cloud

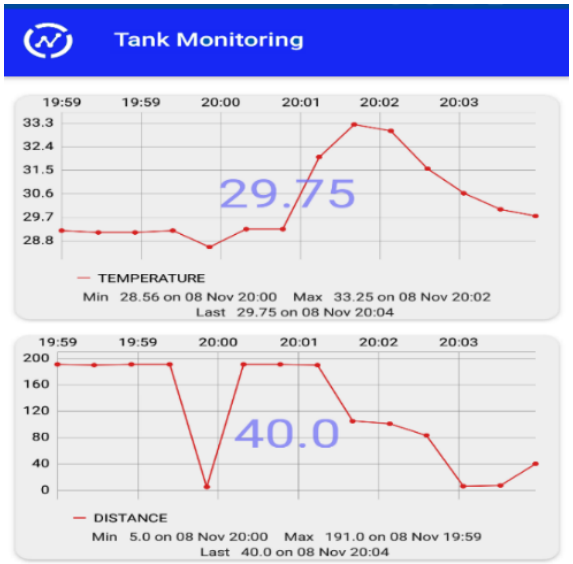

Fig. 8 Data viewed through ThingView app

VII. CONCLUSION

This proposed system measures the chemical process tank parameters using microcontroller and uploads the data to the server. The sensed data is sent to the server via inbuilt Wi-Fi module. In the cloud both real-time data and its graphical analyses can be noticed. Android application is used for the end user to monitor the industrial parameters. As per the results the proposed system consumes lesser power compared to WSN based instruments for chemical process tank parameter monitoring. The installation and configuring the IoT based system is less complex compared to both wired and wireless devices.

REFERENCES

1. Md. Mahmudul Islam, Md. 1Maksudur Rahman, Md. Alimul Islam Salim & Md. ShoaibAkther, "A Wireless Process Monitoring And Control System With Zigbee", American Journal of Engineering Research (AJER), Vol.7, Issue.2, pp-177-183, 2018.
2. D.Manivannan, "Design and development of mobile relay node using LPC2148", International Journal of Advanced Intelligence Paradigms, Vol. 8, No. 4, pp.367-376, 2016
3. Komal S Shinde, Prachi H Bhagat, "Industrial Process Monitoring using IoT", International conference on I-SMAC, August, 2017.
4. Dr.S.W.Mohod, Rohit S Deshmukh, "Internet of Things for Industrial Monitoring and Control Applications", International Journal of Scientific & Engineering Research, Volume 7, Issue 2, pp.494-498, February 2016.
5. P.Dinesh Kumar, M.UmayalSaranya Mano, K.M.Umayaal, B.Subodhini, V.K.Abinaya, "Industrial Monitoring using IoT", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 5, Issue 3, pp.5624-5629, March, 2017.
6. A. Alfred Ignatius, D. Calvin Samjay, R. Prathish and A. InbaRexy, "Automated Monitoring of Industrial Loads using IoT and Control using Wireless Technology", Middle-East Journal of Scientific Research, vol.24, pp.55-58, 2016.
7. Tamilarasan P, Ramya Bharathi J, Keerthana S, Kavitha, "Live Energy Meter Reading - Continuous Monitoring And Analysis Using Thingspeak", nnovare Journal of Engineering and Technology, Volume 6, Issue 1, 2018

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