WSN Based Industrial Waste Water Monitoring System

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Abstract — nowadays water becomes more scarcity in many cities and rural areas. Farmers are also suffered due to lack of water for cultivating crops. On the other hand most of the industries are contaminating the ground water by dumping waste water into the river which has been used by normal people. The toxic present in chemical waste are going to affect the people health. By considering this, we developed a monitoring system incorporated with LoRa technology will measure the concentration of chemical percentage present in water. Although there are many technique used for transferring data. Those techniques are quite expensive and used for short distance communication in many applications. To overcome this disadvantages LoRa comes with low power, Long Range communication. Our proposed system mainly focused on environmental problems due to the industries which are mainly associated with the need for large amounts of fresh water and remittance highly polluted waste water.

Indexed Terms - LoRa; monitoring system; Chemical waste; Long Range communication

I. INTRODUCTION

In our proposed system there are two nodes plays a major role namely sensor node and gateway node. There is N number of sensor nodes placed in an industry connected to a common gateway. Each sensor node will communicate to a gateway by using LoRa technology. In our prototype model we placed one sensor node transferring data to gateway. Sensor node will measure the concentration of chemicals present in waste water. These measured values from the sensor are processed by microcontroller and these processed values are transmitted to the core controller by using LoRa Technology. We consider the pH value as a main parameter at the sensor node, the data collected from the sensor node are aggregated at the gateway. The aggregated data at gateway is processed by core controller and update the data in a goggle sheet for monitoring the waste water. LoRa (RFM95) is one of the emerging technology in IOT application. LoRa stands for low power long range transceiver Module that provides ultra-long range communication uses License-free band of 868 MHz frequency. LoRa is a long range wireless data communication technology developed by cycleo of Grenoble, France and acquired by Semtech in 2012. The connector type of LoRa is SPI/I2C.RFM95 LoRa module can achieve a sensitivity of -148dB and 168 dB maximum link budgets. Bit rate of LoRa module is 300Kbps. FSK modulation technique is used for modulating the original data to travel long distance. LoRa is the best way to get good receiver sensitivity and low bit error rate (BER). The basic principle of Spreading factor is that each bit of information is encoded as multiple chirps and its range is 7-12. LoRa wireless system use frequency shift keying (FSK) modulation as the physical layer because it is a very efficient modulation for achieving low power as well as significantly increases the communication range. The communication range will be 20Km in line of sight, 5km urban area, 12-15km in rural area. ESP32 is a series of low-cost, low-power system on chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The features of ESP32 includes 2-bit SAR ADC up to 18 channels, 2 × 8-bit DACs, 4 × SPI, 2 × I²C interfaces, 3 × UART, Ethernet MAC interface with dedicated DMA and ultra-low power analog pre-amplifier.

II. PROPOSED DESIGN

A. Block Diagram:

The proposed system provides essential functionality like monitoring the waste water, the block diagram of the proposed system is shown in Fig.1. The proposed system is designed in a manner such that the gateway will be placed in a common point and N number of sensor nodes is present in different places. Our work aims to implement a long distances wireless communication with low power consumption in IOT applications.

The system acquires data from the pH sensor as inputs and process the same using microprocessor, the output of the processor will be transmitted using LoRa technology. The LoRa technology is now commonly used in industry, which provides long distance communication upto 20Km. LoRa uses FSK modulation technique and modulates the original data before transmission. It is the most efficient way of transmitting data for long distance in IOT applications. It also consumes low power which is best suited for battery operated devices.

The sensed data from the sensor node is also displayed in OLED that are connected to microprocessor using I2C communication. The data received at gateway is processed by core controller and further the data is updated in internet by using inbuilt Wi-Fi module in processor for monitoring the industrial waste water.

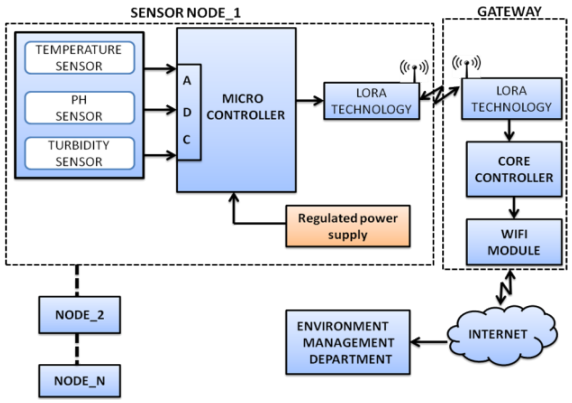

Fig.1. Block Diagram of proposed system

The above block diagram is the overall proposed system which is mainly based on wireless sensor node used for monitoring the industrial waste water.

B. Algorithm:

The work has been implemented to monitor the waste water which contains different concentration of chemicals like acidic and alkaline. The pH value below 7 is acidic and above 7 is alkaline. It is essential to monitor these waste waters. The flow chart of sensor node shown in Fig.2.

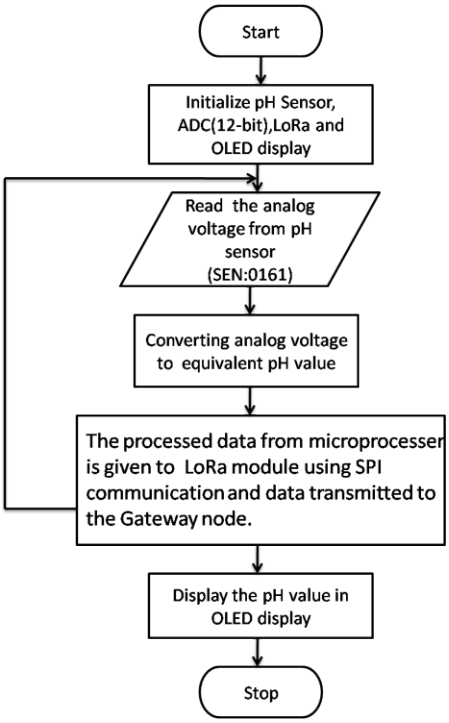

Fig.2. Flowchart of sensor node

C. Experimental Setup:

The work was implemented as a prototype to monitor the industrial waste water. The proposed system was prototyped using ESP32 processor. This is advanced processor used for many applications. This processor is a 32 bit processor, which has a inbuilt Wi-Fi module and hence suitable for IOT based applications.

The experimental setup of the proposed system is shown in Fig.5. The input data's are acquired from the pH sensor, and provided as input to the pH module.

Usually data will go through some pre-processing technique, so that processing can be achieved. This improves the bandwidth efficiency of the network

Fig.3. Experimental setup of Sensor node

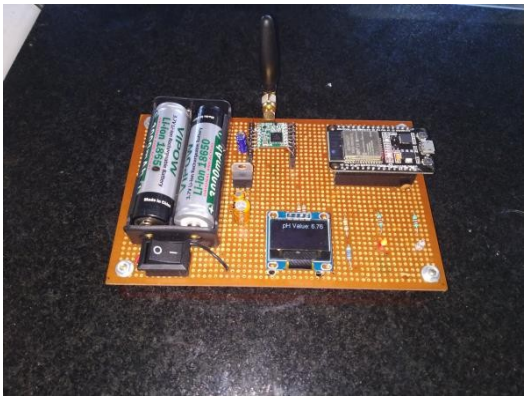

Fig.4. Experimental setup of Gateway node

Fig.5. Experimental setup of prototype model

III. RESULTS AND DISCUSSION

A. Test Case:

The prototype was tested, for the following test cases.

1) Test case 1: Processing of data corresponding to acidic solution (Example : HCL)
2) Test case 2: Processing of data corresponding to alkaline solution (Example: NaOH).
3) Test case 3: Processing of data corresponding to neutral solution (Example: water).
4) Test case 4: Wireless transmission using LoRa Technology.
5) Test case 5: Updating the acquired data in internet using Wi-Fi.

The processing of data using Test case-1 is shown in Fig.6.

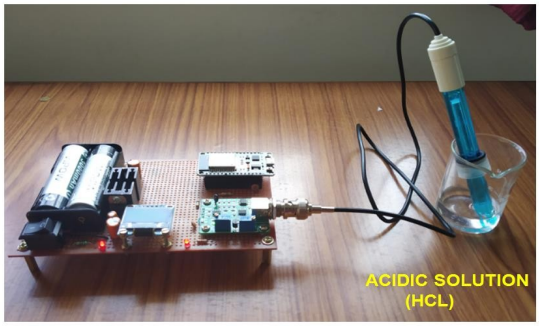

Fig.6. Testcase-1

IV. CONCLUSION

A system was considered to provide low cost waste water monitoring system. This system provided wireless sensor node based waste water monitoring system as standalone functionality for the end user. Since it is a battery operated and portable device, we can easily place it in industries and maintain the whole system. It is independent of external power supply which is best suited for industry. The flaw in such a system is that data rate is 300kbps. Hence the system we have considered is very much useful to the industry to monitor the waste water from each section.

V. FUTURE WORK

Our work has considered a system for monitoring the waste water. Such a system is very useful when we consider that we do some data analytics and predict the result for better monitoring the system .It will measure the concentration of chemicals presents in waste water and control it based on its threshold value before releasing it into river or land. Besides all these data's are send to the cloud server where the environment department can do some data analytics for prediction or to generate a report.

In such system there is no proper technology for wireless transmitting of data for long distance with low power consumption. Hence LoRa will provide these features for IOT based applications could be chances where your paper receives number of critical remarks. In that cases don't get disheartened and try to improvise the maximum.

This completes the entire process required for widespread of research work on open front. Generally all International Journals are governed by an Intellectual body and they select the most suitable paper for publishing after a thorough analysis of submitted paper. Selected paper get published (online and printed) in their periodicals and get indexed by number of sources.

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