



CHEMICAL FLOW DISRUPTION MONITORING SYSTEM USING PLC

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Abstract

The systems which currently exist have proved to be an effective solution for preventing the damages in the pipeline, yet during catastrophic situations, their role is being reduced by certain problems in the transmission line. Therefore, the proposal is based on implementing a system which specializes in monitoring as well as analyzing the fluid flow via the transmission line. The transmission line is connected to two turbine type flow sensor each connected on either side of the pipe. The flow sensors are connected to a PLC is connected to internet through RJ 45 communication port. The real-time data are stored in Thingspeakserver. By implementing this system, the data can be used to view the amount of chemicals that are flowing through the transmission line. In case of any leakage or blockade in the pipe, the PLC first analyses the signals sent by the flow sensors. If any deviation is present within the signal the PLC will instantaneously sound the alarm and will also report the service centre via email.

INTRODUCTION

The chemical industries have been an integral part of the global economic sources for many centuries. The chemical plants were built during the industrial revolution, when the chemical processes for making concrete and waterproof clothing were devised. Since then, the industry has evolved to become a bastion of productivity that permeates through nearly every good-producing sector. Today's chemical plants plays a prominent role in focusing on the economics in every nook and corner of the world and in most of the sectors that are sided with the economics. Moreover, the chemical industries comprise of companies that produce chemicals in industrial standards. To the modern world economy, it converts raw materials such as raw materials, natural gas, air, water, metals, and minerals into more than 70,000 different products. There are diverse personnel's who are deeply involved in the industries including chemical engineers, scientists, lab chemists, technicians and so on. As per the survey of 2018 the chemical industry comprises approximately 15% of the US manufacturing economic sector

Technical advancements:

So in order to counteract these indiscretions certain advancements were added to the chemicals which were responsible for automatically monitor the flow of the chemicals through the transmission lines. The transmission was connected to flow meters on either sides to record the inlet and outlet of the chemicals in the pipe. This improved the industries in reducing the chance of engendering a chemical explosion. Though sensors were used by the industries, yet the leakage and blockade within the pipe tend to form due to some catalyst being the important play. It was still not clear that was the pipe transferring the chemical flawed or the workers who were inside the factory were nonchalant of their responsibility in reporting the problem to the service centre or to their higherofficials.

Datatracking:

There are highly flammable chemicals which has a lot of applications that are used in day-to-day lives of the human beings. In order to reduce threat of these chemicals a system must be designed in such a way that it must work between the temperature of 60 -120 deg. Celsius. The objective of the project is to monitor the difference between the flow in the inlet and outlet of the pipeline. Once, the difference is recorded, the signal is sent by the PLC in the system to the Node MCU for sending the email as an intimation to the service stations stating the leakage or blockade in the pipeline.

Creating applets for IFTTT:

The **IF This Then That**, abbreviated as **IFTTT** protocol is a freeware web based service that creates chains of simple conditional statements, called *applets*. An applet is triggered by changes that occur within other web services such as Gmail, Facebook, Telegram, Instagram, or Pinterest. There are several steps involved in creating the applets that are required for creating the actions that will help the system in performing the necessary functions once the flow difference is sensed.

Step 1 : Selection of mode for action

The initial is all about choose the course out of the listed functions. We are in need of an email for reporting the leakage problem so we need to click on the email toolbar.

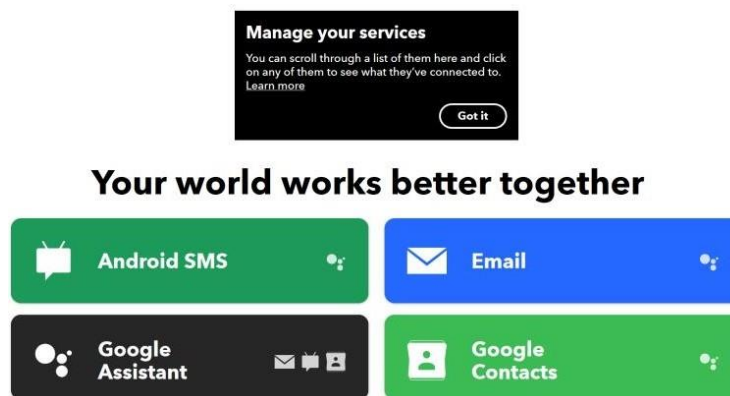


Figure1: Welcome page

Step 2: Setting the if condition

After clicking the email toolbar, a page will displayed in the screen stating to choose the if condition. Now we have to click on the **This** tool bar.

Step 3: Filling the required statements

After clicking on the **This** tool bar a wizard will open showing us the areas in which we have to fill in the necessary commands for the process. After this we need to sync the data to the thingspeaks server with the API key of the program created using the Arduino programming such that the protocol will read the signals sent by the NodeMCU.

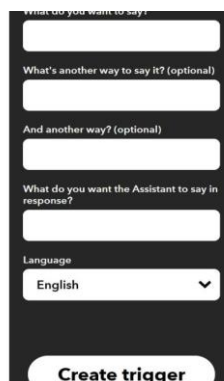


Figure 2: Filling data

Step 4 : Creation of action protocol

This step involves the creation of the response action of the system. Once step 3 is completed, another page flashes in screen stating to click in the **That** tool bar.

Step 5 : Filling the conditions for the response action

After step 4 is completed the next set of the procedure is been reached in the report creation. Now the response has to be filled with necessary details.

Result and discussions:

The prototype is placed near the pipeline of the chemical plant such that the flow sensors are properly wired to the module to check the flow rate of the chemicals via the transmission lines. The data which is being read by the NANO due to changes in the flow rate is sent to the PLC in the form analog values, as the PLC reads the input in the form of Milli amperes. The PLC on receiving this analog input now will work according to the logic of finding the difference between the flow readings. If the difference is found the PLC will send the digital signals to the Node MCU. The Node MCU module will be connected to the server and will upload the data instantaneously into the website channel. Also, the MCU module will sound the alarm in the factory and there by also sending an email to the service center. The figure below is the pictorial representation of the website interface of the project.

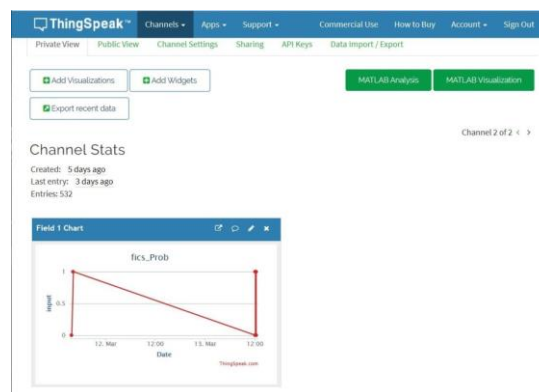


Figure 3: Website interface

The data which is being uploaded to the server be exported into the excel sheet. Also, option of adding visualizations and widgets that can be used to analyse and visualize the real-time data for the end user. The statistics about how much amount of fluid is flowing via the pipeline. This graph will change according to the sensor readings to the corresponding fluid flow. The values in the graph are transcription of binary values if the value of the reading is 1, then there is a change the fluid flow rate. If the digital signal reading is 0, then there is no change in the flow of the chemicals in the transmission pipeline. Also the graph can only represent the data for the couple of days. Then, the PLC will refresh itself as the memory gets is about to be full.

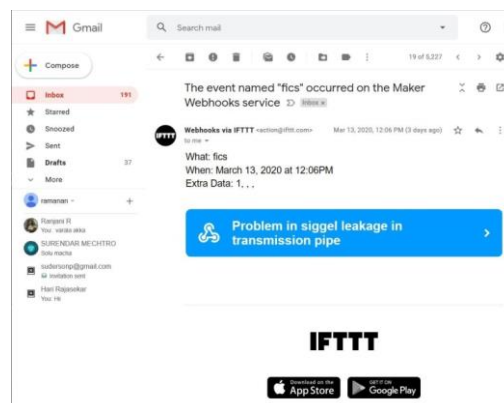


Figure 4: Email to service center

The above figure is picture representation of the email which will be sent to the service centers that notifying the leakage in the pipeline. Once the PLC senses the difference in the chemical flow, it sends the signals to the Node MCU.

Conclusion

The chemicals are yet to face a tons of catastrophes in the mere future, provided the chemicals with highly volatile nature are used in the various industries within diverse applications. The incidents of leakage will imminently occur due to weakening of the industrial pipelines or workers who are prone to make errors. Yet, the system which is designed will act as a profound solution for reducing such errors to a minimum and ensuring the safety of the workers and industry. The service stations will instantly get the message via email as the PLC which controls the system reacts with concurrently as it notices the changes within the fluid flow through the pipeline through the readings sent by the flow meter. The workers in the industry also receive the notification via a central alarm and the data of the chemical flow can also exported to excel sheet for maintaining a record and the chemicals flowing through the pipeline for references in the merefuture.

References

- [1] Anek Wong Yoddumnern, Thongchai Yooyativong and Rungsan Chaisricharoen (2017) ECTI-CON , school of information technology, Mae Fah University, Chiangrai , Thailand. The Wi-Fi multi-sensor network for fire detection mechanism using fuzzy logic with IFTTT process based on cloud.
- [2] Buhler AG , Uzwil and Daryoush Sangi , Winterthur ,United States patent publication (2018). Adaptive cross plant control and steering system and corresponding method.
- [3] Daryoush Sangi , Winterthur ,United States patent publication (2018). Method and system for process controlling of plants in an OPC - UA based machine - to - machine network.
- [4] Donald F. Ruffner and Paul D. Olivier , Scottsdale, Ariz (1997) United States patent publication. Wide range, high accuracy flowmeter.
- [5] Monika Kashyap, Vidushi Sharma and Neeti Gupta, Gautam Buddha University, Greater Noida, India, ICCIDS 2018. Taking MQTT and Node MCU to IOT: Communication in Internet Of Things.

Websites links

- [6] ABB PLC link: <https://new.abb.com/plc/automationbuilder/plcs>
- [7] Arduino Nano : <https://www.theengineeringprojects.com/2018/06/introduction-to-arduino-nano.html>.
- [8] Calibration Techniques: <https://www.flowcontrolnetwork.com/instrumentation/flow-measurement/article/15562783/flowmeter-calibration-recalibration-what-you-should-know.48>
- [9] Flow meter link : https://new.abb.com/products/measurement_products/Flow/electromagnetic-flowmeters/process-industry/processmaster-fep610.
- [10] Hall effect flow sensor : <http://www.hobbytronics.co.uk/yf-s201-water-flow-meter>.
- [11] IFTTT interfacing with node MCU: <https://www.hackster.io/igorF2/iot-air-freshener-w-nodemcu-arduino-adafruit-io-ifttt-dcf959>.
- [12] Node MCU : <https://www.electronicwings.com/nodemcu>.