

# INDUSTRIAL PROCESS CONTROL SYSTEM USING IOT

Dr.B.D.Jadhav

Associate Professor of Electronics & Telecommunication Department  
JSPM's Rajarshi Shahu College Of Engineering  
Pune,India

Pradeep.R.Jadhav

PG Student of Electronics & Telecommunication Department  
JSPM's Rajarshi Shahu College Of Engineering  
Pune,India

**Abstract-** Internet of Things (IOT) is the network of devices and it plays a crucial roles in many fields. IOT concept in the field of industry gives a new technology i.e. industrial internet of things (IIOT). IIOT also referred as industrial internet. Industrial internet brings many devices and machines in a network to communicate. The proposed system is a closed loop system for liquid fuel flowing through pipe. The design system is replacement of high cost SCADA based system. There will be three independent modules control system electronics module, IOT cloud server and remote monitoring. Electronics module consist of flow sensor, temperature sensor and level sensor which acts as feedback input for closed loop system. This module uses raspberry pi as a controlling processor and relay is being used as output. . Inbuilt WIFI into raspberry pi is used to send data to our cloud server. Things peak Cloud Server is used to store the data. For remote monitoring and controlling the process, an interface has been designed, through which the user can set the flow rate, level to go and other parameters. This interface also provide information about temperature, liquid levels and flow rate.

**Keywords-** Raspberry pi, flow sensor, level sensor, temperature sensor, thingspeak cloud, QT designer.

## I. INTRODUCTION

In the recent years, there has been a rapid increase in the digitization in the field of industry. The term, the Industrial Internet of Things, has become increasingly more pervasive in the context of industry as digitization has become a business priority for many organizations. The Industrial Internet of Things (IIoT), also known as the Industrial Internet, brings together brilliant machines, advanced analytics, and people at work. It is the network of a multitude of devices connected by communications technologies that results in systems that can monitor, collect, exchange, analyze, and deliver valuable new insights like never before. It is the network of a multitude of devices connected by communications technologies that results in systems that can monitor, collect, exchange, analyze, and deliver valuable new insights like never before. These insights can then help drive smarter, faster business decisions for industrial companies. The proposed system is replacement of high cost SCADA based system and on top of that integration of IIOT into the same. The proposed system is closed loop control system for liquid fuel flowing through pipe. In this project, raspberry pi plays the major role. It is used as a controlling module. There will be three independent modules, control system electronics module, IOT Cloud Server and remote Monitoring/controlling User Interface. Control System electronics module consist of flow sensor, temperature sensor and level sensor which acts as feedback input for our closed loop system. This module uses raspberry pi as a controlling processor and relay is being used as output. Inbuilt WIFI into raspberry pi is used to send data to our cloud server. Thingspeak Cloud Server is used to store the data. For remote monitoring and controlling the process, an interface has been designed, through which the user can set the flow rate, level to go and other parameters. This interface also provide information about temperature, liquid levels etc.

## II. RELATED WORK

This section includes various methods described by authors.

Authors in [1] have used cryptography algorithm which provides a secure transmission channel between the field devices in the SCADA system. Numbers of secret keys are generated and distributed among the nodes to avoid the requirements of certificate authority (CA). Encryption at receiving side and decryption at target side are performed using same secret key.

Authors in [2] describes the future research directions to secure critical cyber physical system (CPS). They highlights the security challenges of critical infrastructure (CI) for perspective of IOT & cloud computing. The efforts being made by authors to secure the SCADA system within the future internet environment.

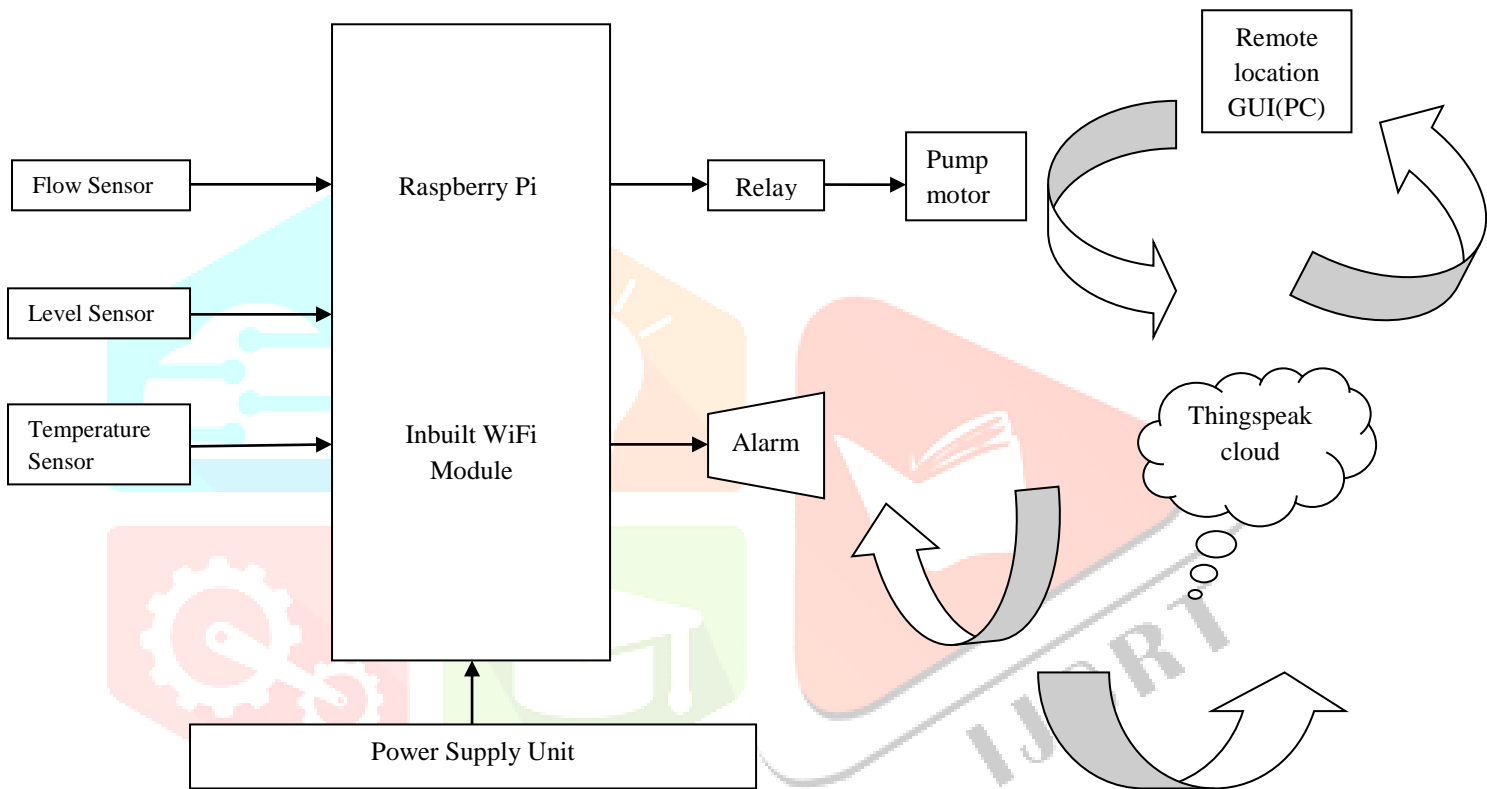
Authors in [3] gives an outlook towards security & privacy challenges for Industrial IOT systems. They describes brief explanation about cyberphysical systems (CPS). They provides some knowledge related to attacks ,attack surfaces on industrial IOT systems. Integrity verification of CPS and secure architectures for CPS is described in this paper.

Authors in [4] designs a system which controls the indoor & outdoor temperature. This system installs some temperature sensors with LCD display to inform users about indoor and outdoor temperature. System also installs some network controller to gather some information from temperature sensors, users and ball valve controllers. IPC is provided to send information to the server.

Authors in [5] designs a Network virtualization for flow sensors. The scenario makes flow sensors resources to share and escalation of reachability under same platform. Flow sensors makes ease to investigate on experimental traffic ,protocol and overall network.

### III. METHODOLOGY

#### 3.1 Block Diagram



#### 3.2 Block diagram description

The proposed system consists of following components-

- Raspberry Pi(ARM Cortex A53)
- Flow sensor
- Level Sensor
- Temp Sensor
- Relay
- Pump Motor
- Buzzer Alarm
- 12 Volt Power Supply

##### 3.2.1 Raspberry Pi :

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B .The popular board format the Raspberry Pi 3 Model B brings a more powerful processor,10X faster than the first generation Raspberry Pi. Additionally adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.It includes broadcom BCM2837 chipset,1.2ghz quad-core arm cortex-A53,1GB RAM,64 bit CPU,full size HDMI,4 pole stereo output and composite video port,CSI camera port,DSI port.

Package include is 1x raspberry pi 3 model B.

### 3.2.2 Flow Sensor :

Water flow sensor consists of a plastic valve body, a water rotor, and a hall-effect sensor. When water flows through the rotor, rotor rolls. Its speed changes with different rate of flow. The hall-effect sensor outputs the corresponding pulse Signal. Its specifications includes working voltage 5-24V, maximum current 15ma, flow rate range 1-30 L/min, operating temperature 80°C, operating humidity 35%-90%RH.

### 3.2.3 Temperature Sensor:

Temperature sensor is a device which is designed specifically to measure the hotness or coldness of an object. LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C) also possess low self heating and does not cause more than 0.1 °C temperature rise in still air. The operating temperature range is from -55°C to 150°C. The LM35 is low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It has find its applications on power supplies,battery management, appliances,etc.The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. The LM35 has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/°C.

### 3.2.4 Level Sensor:

Level sensors detect the level of liquids and other fluids and fluidized solids, including slurries, granular materials, and powders that exhibit an upper free surface.The level measurement can be either continuous or point values.Float level sensor operates with an internal magnetic reed switch and an external magnetic field mounted in the float. The reed switch is classified by its maximum power ratings and magnetic sensitivity. Because this is a dry contact, it stores no power. The float on the outside of the stem provides the magnetic field to activate the internal reed switch.

It includes maximum power of 50w, maximum switching voltage is 220 v dc, maximum switching current is 1.5A, temperature range is from 10-85°C. Its package 1x2 side position sensor.

### 3.2.5 Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults.

Its specification includes maximum switching current 10A, switching voltage 250V AC, ambient temperature is -40 to +85°C.

### 3.2.6 Buzzer alarm:

A buzzer is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.It includes rated voltage is 6v dc, operating voltage is 8v dc, rated current is <30ma, operating temperature -25 to +85°C.

### 3.2.7 Pump motor:

The motor is a brushless dc motor. Its specifications involves power rating of 18w, flow rate of 1100L/H, voltage range is 220-240 v,

Power cord length is 115cm, dimension is 100\*100\*100(mm).

### Selection Criteria (mathematical calculation):

$$\text{Volume of Tank} = 200 \times 200 \times 300 \text{ mm}^3 = 12000000 \text{ mm}^3$$

Since 1 mm<sup>3</sup> in volume equals: 0.0000010 liters, hence 12000000 mm<sup>3</sup> of Tank will be (0.0000010\*12000000) equals 12 L

Flow rate: 1100 L per hr i.e. 1100/60 L per minute i.e. 18.33 L per minute i.e. 0.3 L per second

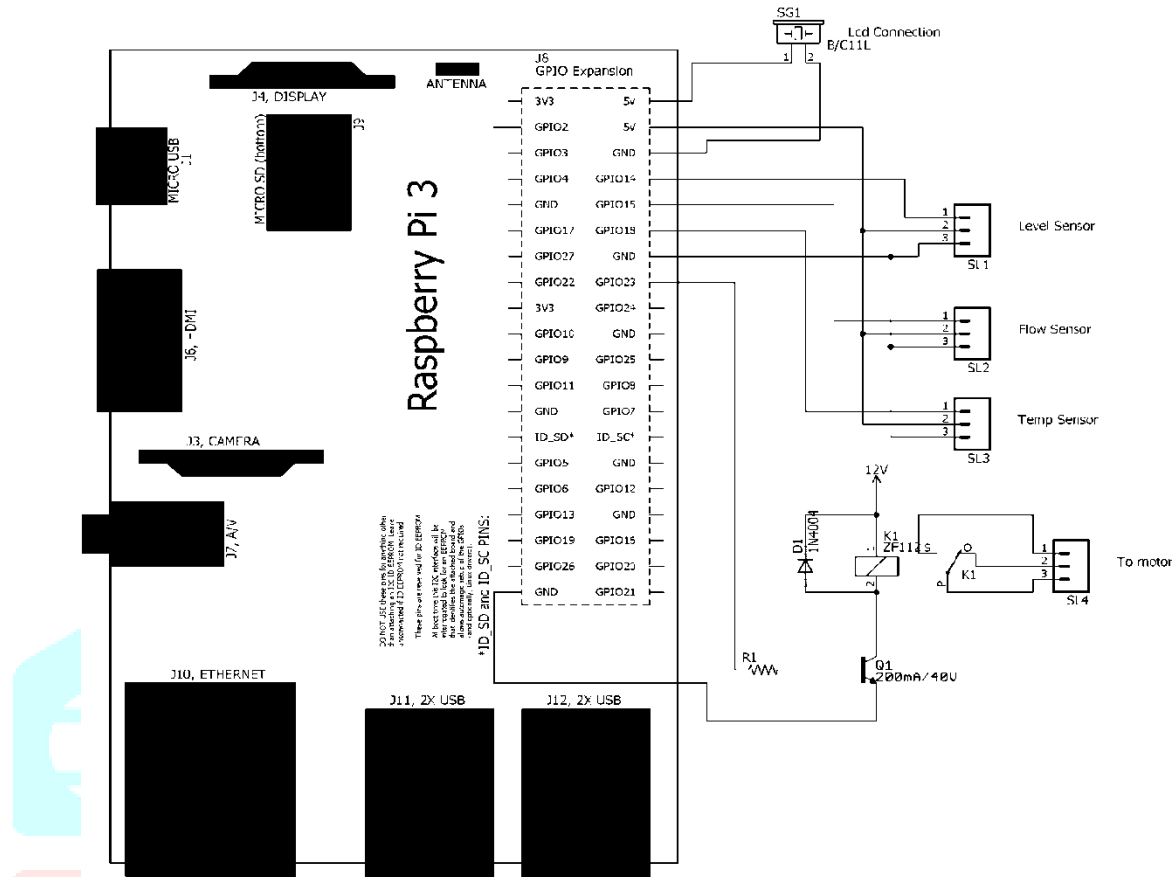
Time takes to fill up the tank = 12/0.3 = 40 second (aprox.)

I have placed 4 water level sensor, the time to reach each level from the previous one will be 40/4 i.e. 10 second approx.

Note\*- I had selected this motor because this one is best suited-closely fulfilling the requirements(in terms of cost and efficiency) for the prototype/model making.

Note\*- the above calculation is theoretical based on the data provided by the motor manufacturer, actual time may vary slightly in the practical scenario.

### 3.2.8 Circuit diagram of proposed system



### IV.RESULT

In this process control system sensors sends the data of a given input to raspberry pi and it transmitted through thingspeak cloud.The data given by cloud is visualize and it is monitor in graphical user interface using qt designer tool.This process is used to achieve a production level of consistency,economy and safety which could not be achieved purely by human manual control.The current process system is implemented widely in industries such as oil refining,pulp and paper manufacturing,chemical processing and power generating plants.

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