Microcontroller Based Toxic Liquid Level Monitoring Control System

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Abstract

The main goal of this system is to meet the requirement of user as it reduces even also avoids the manual operations of employee which produce or gives toxic liquids as outputs. In a typical liquid level application, the user wishes to optimize his requirements by better controlling the fluid level within the tank. . This avoids under fill and overflow of liquid as well as down time during tank refill. A simple and cost-effective method of measuring the height of fluid in a tanker is by using ultrasonic waves. It will provide a cost-effective. Measuring liquid levels in real time, which facilitates user to know actual liquid level in a tank at that instant as well as liquid level in the tank in past 24 hours by data logging. Nowadays under developed countries uses early technologies to measure a tank filled with toxic liquids. We are decided to develop a computerized system to monitor and control toxic liquid level. In our environment we have seen a lot of problems such as related to environment, Traffic accident distance measurement, Gaussian measurement that is guess using time and using visualization, to measure accurate speed measurement and Measurement of irregular shape.

Keywords: Toxic, Atmega Microcontroller, Ultrasonic Sensor, Maxsonar

1. Introduction

The most of the chemical factories produce some toxic and acidic element as output and this output has to come in some storage which is far apart from the site of those industries location because of that those liquids are pumped away from their synthesizing are the some output tanks, While tank has to be filled after sometime. So the employee of the industries have to control the level of the tank because overflow may cause environmental pollution, to avoid such problem the employee of the company need to control the level of the tanks and employee cannot go directly to the site of the tank to detect the level of the tank because of those toxic acidic liquid may transpire some harmful gases in reaction. In the past year, some industries have tried to overcome such problems by using some certain techniques such as alarming control, manual detection and some electrical techniques. While those techniques where in sufficient to overcome some problem. Because you need to keep in touch some medium with the liquid. As chemical definition, acid are highly reactive material which causes some reaction with the medium. This reaction changes the status of medium to assign the correct level and also in affect of misusing of element. Overall techniques where not effectives, so that we had triggered to overcome such fail special sensors that has no in touch medium in the liquid which is most effective.

Fig-1: Early Level Measurement

To solve this all problem using the existing system is not applicable because they don't have accurate measurement . as well they can't fully control by the system in case something happen like if it is holiday , no human, etc., Now days with the help of ultrasonic sensors, infrared, radio frequency, Bluetooth and all sensors, Humans can control whatever they want remotely. Considering this technologies which can give us more benefit than the existing system. Our group decide to use this technologies in order to solve the problem occur in the industrial companies with less energy used.

So our proposed system tries to measure irregular shapes by measuring accurate distance at certain time and monitoring we choose ultrasonic sensor because the existing system used metal sensor in order to monitor and control irregular shapes. Considering this in account how many metal sensor do we use in a period of time? What is the life time of each metal sensor? How many it can measure. In order to solve the above problem we want to use ultrasonic sensor which can give us more efficiency and benefit than the metal sensor.

The specification of ultrasonic sensors we use is **MaxSonar®**

EZ1™. This sensor implement on the top tank or container. This system gives information in the form of signal with the help of microcontroller you specify at which level you want to measure and monitoring it. The type of ultrasonic we use can be measure up to 6.75 meters.

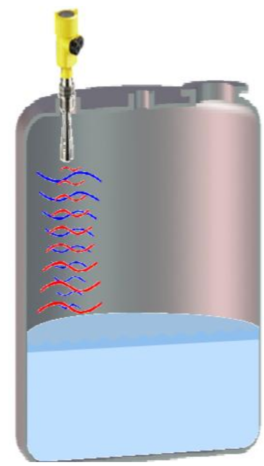


Fig-2: Model Description for Level Measurement

2. Toxic Level System

In this accurate measurement to avoid the time guessing visual assumptions, exact controlling and monitoring. [i.e. Long life of up to 26 years], avoids mismatch of understanding. Continuous measurement delivery irregular shape maintaining and working system is not affected by the following conditions.

1. density (specific gravity)?
2. dielectric constant?
3. conductivity?
4. temperature?
5. pressure?
6. vacuum?
7. agitation?
8. vapours and condensation?
9. dust and build up?
10. internal structures?

To compare the single metallic sensor with single ultrasonic sensor with single ultrasonic sensor . metallic sensor is cheapest but the life time of metallic sensor is short. This means that you can spend more money multiple times than the single sensor for 26 years. By using this technology, user can control at their desired level. This system is safety and reliable.

3. Research Output Design

After building, assembling or compiling this work, the build output window prompts with messages. If any errors occur, the user can double-click on the message, and the marker will show correct position in the source window.

3.1 Platform Independent Debug Environment

Independent of which debug platform is running, the AVR Studio environment will appear identical. When switching between debug platforms, all environment options are kept for the new platform. Some platforms have unique features, and new functionality/windows will appear.

3.2 Platforms

Although all debug platforms appear identical in the debug environment, there will be small differences between them. A real-time emulator will be significantly faster than the simulator. An emulator will also allow debugging while the system is connected to the actual hardware environment, while the simulator only allow predefined stimulus to be applied. In the simulator, all registers are always potentially available to be displayed, which might not be the case with an emulator. While the AVR Studio User's Guide describes the general behavior of AVR Studio, these differences are thoroughly described in the platform's User Guide.

3.3 Status Bar

The Status bar always indicates whether debugging is targeted at the AVR In-Circuit Emulator or the built-in AVR Simulator. The name of the actual device and debug platform is output on the lower status bar:

3.4 How does the microcontroller operate?

Even though there are a large number of different types of microcontrollers and even more programs created for their use only, all of them have many things in common. Thus, if you learn to handle one of them, you will be able to handle them all. A typical scenario on the basis of which it all functions is as follows:

1. Power supply is turned off and everything is still the program is loaded into the microcontroller, nothing indicates what is about to come.

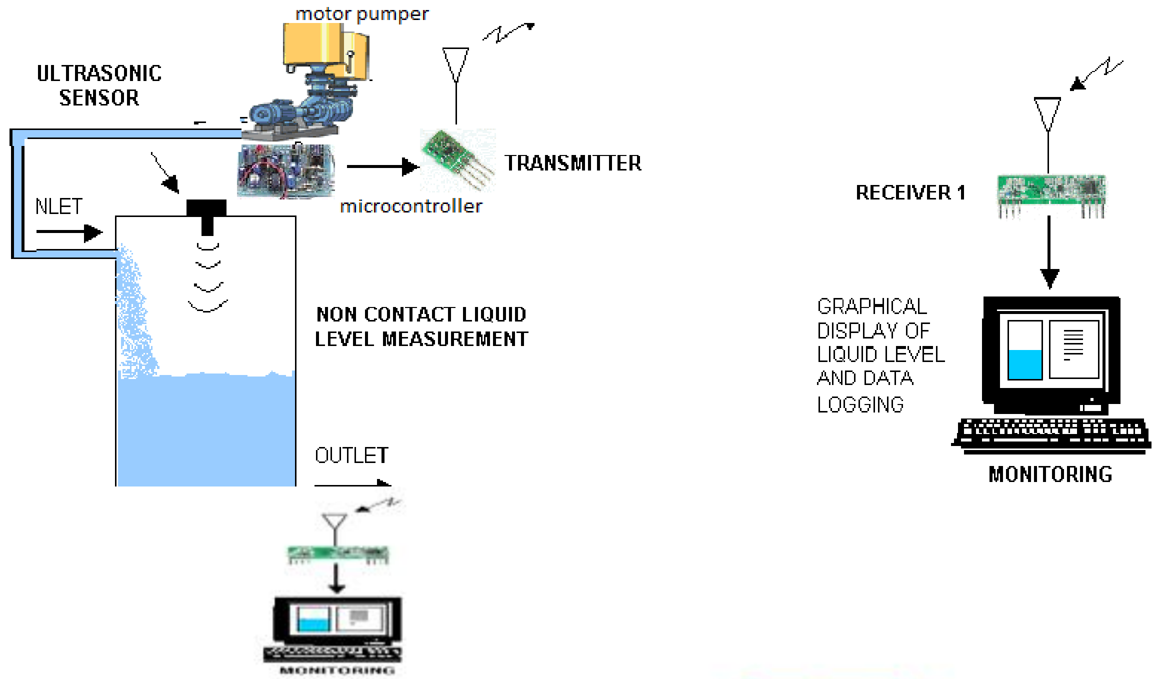
2. Power supply is turned on and everything starts to happen at high speed. The control logic unit keeps everything under control. It disables all other circuits except quartz crystal to operate. While the preparations are in progress, the first milliseconds go by.

3. Power supply voltage reaches its maximum and oscillator frequency becomes stable. SFRs are being filled with bits reflecting the state of all circuits within the microcontroller. All pins are configured as inputs. The overall electronics starts operation in rhythm with pulse sequence. From now on the time is measured in micro and nanoseconds.

4. Program Counter is set to zero. Instruction from that address is sent to instruction decoder which recognizes it, after which it is executed with immediate effect.

5. The value of the Program Counter is incremented by 1 and the whole process is repeated several million times per second.

The whole configuration is obviously thought of as to satisfy the needs of most programmers working on development of automation devices. One of its advantages is that nothing is missing and too much. In other words, it is created exactly in accordance to the average user‘s taste and needs.



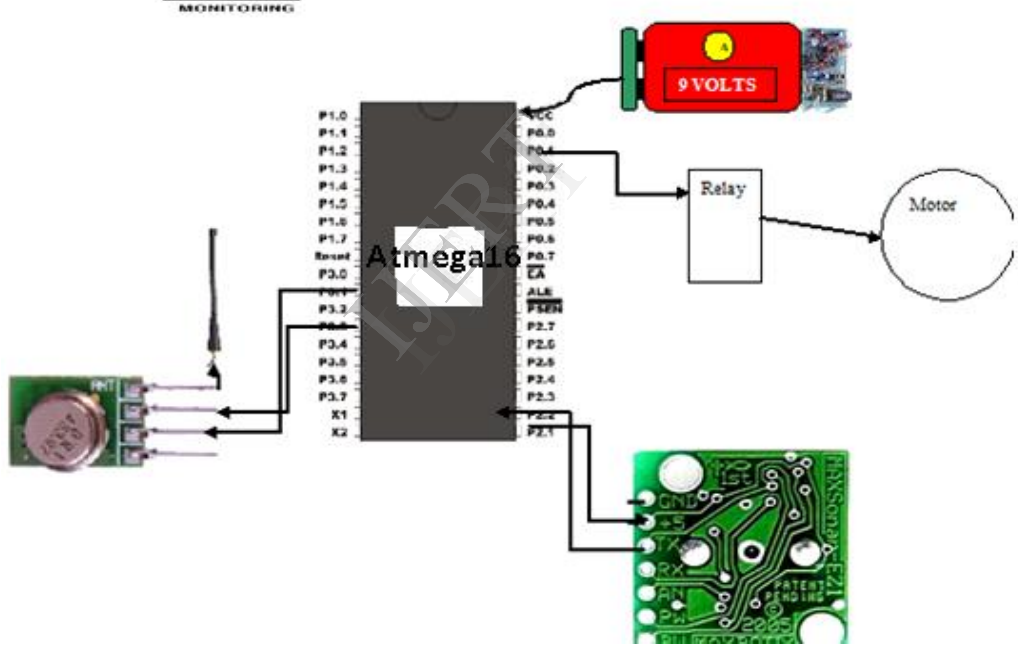


Fig-3: Circuit diagram of liquid level Monitoring and controlling

4. Working Design

The time it takes for the instrument's signal to leave the sensor, travel to the product, and return to the sensor is calculated into distance. The instrument is spanned according to the *distance* the 100% and 0% points with in the measured distance can be converted into the end user's desired engineering unit in the form of oscilloscope in a remote display. Microwave energy is transmitted by the ultrasonic sensor. The microwave energy is reflected off the product surface. The ultrasonic sensor receives the microwave energy. The time from transmitting to receiving the microwave energy is measured. The time is converted to a distance measurement and then eventually a level. AN Output -This output is very easy to use. If any

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voltmeter, just measure between the AN output and GND. The user will measure 10mV per inch. TX Output - Use the TX output, to use a PC and would like to verify the TX output. If it is serial connection of a DB9, TX on the MaxSonar®-EZ1™ is connected to the DB9-Pin 2, and GND on the MaxSonar®-EZ1™ is connected to the DB9-Pin 5 as shown in figure 3. Use a HyperTerminal on the most of Windows PCs.

This the MaxSonar®-EZ1™ is screwed on the top of the tanker over the liquid product after power is supplied to this sensor, it produce some microwaves to its font surface and gets bounced back to sensor as a result this sensor will provide voltage difference to is pins and this out voltage is scaled for 10mV which represent 1 inch length this is determined in the microcontroller which already had been received through it pins in the Atmega16 microcontroller in its some of its port which accept some analog signal which are converted or interpreted as digital signal in the microcontroller. Here the microcontroller gets the voltage difference and convert to some length measurement and this will be send to the computer through RF transmitter to the computer which displays the output on the provided oscilloscope of the computer interface. If the MaxSonar®-EZ1™ gives maximum voltage to the microcontroller automatically the controller sends command to turn off the pumping motor that implies the tanker already reach to its maximum amount of its volume. The interface in the pc will just help to remotely control of the system.

5. Ultrasonic Sensor (Lv-Maxsonar®-Ez1™)

This ultrasonic sensor is the High Performance Sonar Range Finder With 2.5V - 5.5V power the LV-MaxSonar®- EZ1™ provides very short to long-range detection and ranging, in an incredibly small package small package with ultra-low power consumption. The LV-MaxSonar®-EZ1™ detects objects from 0-inches to 254-inches (6.45-meters) and provides sonar range information from 6-inches out to 254-inches with 1-inch resolution (2.5cm). Objects from 0- inches to 6-inches (15cm) range as 6-inches. The interface output formats included are pulse width output, analog voltage output, and serial digital output

Table-1: Ultrasonic sensor values

A. No	Weight - Grams	
A	0.785”	19.9mm
B	0.870”	22.1mm
C	0.100”	2.54mm
D	0.100”	2.54mm
E	0.670”	17.0mm
F	0.510”	12.6mm
G	0.124”	3.1mm
H	0.100”	2.54mm
I	0.610”	15.5mm
J	0.645”	16.4mm
K	0.735”	18.7mm
L	0.065”	1.7mm
M	0.038”	1.0mm

5.2 What is the beam width of the MaxSonar®-EZ1™ in degrees?

Many users have asked for the beam width of the MaxSonar®-EZ1™. For any ultrasonic range finder, the beam width is a function of the sensor used and the system gain following the sensor. System gain for the MaxSonar®-EZ1™ gain is actively and continuously adjusted by the MaxSonar®-EZ1™ system software to yield a long comparatively narrow beam. Figure 5 below shows the target detection angle of the MaxSonar®-EZ1™. Most objects are detected in the central 36 degree zone. The actual detection zone, is a cone that, extends from the front of the detector face.

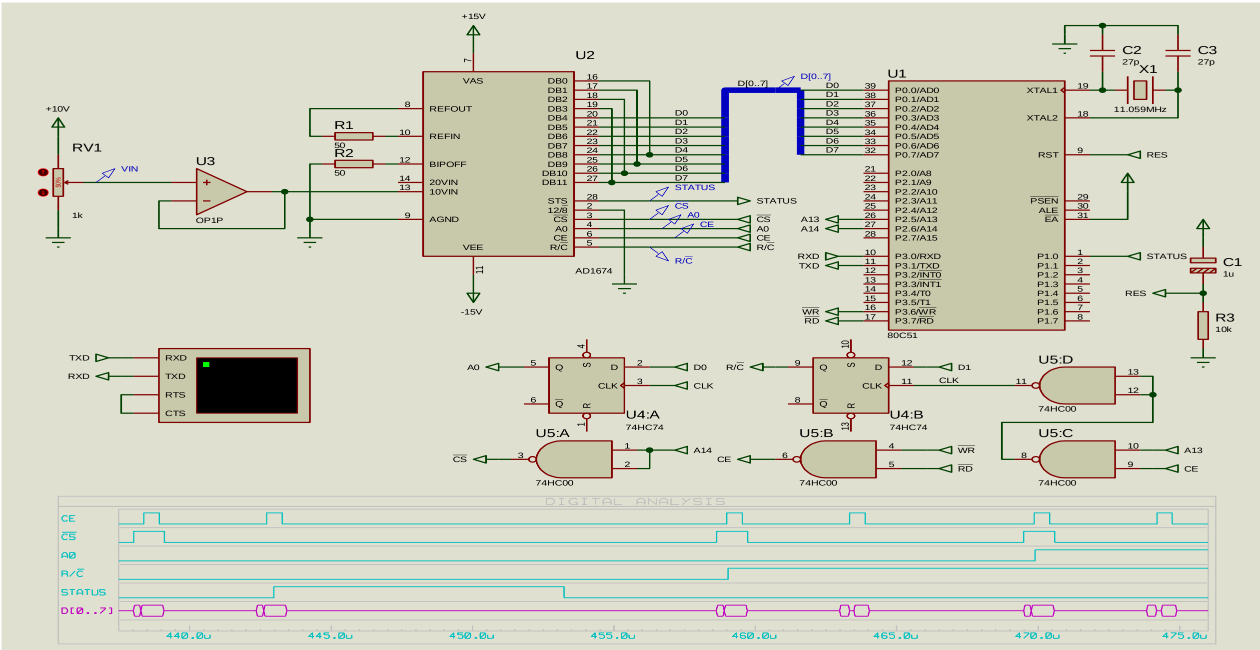

Fig-4: Maxsonar System with Timing diagram

5.3 Max Sonar Beam Characteristics

People detection requires high sensitivity, yet a narrow beam angle requires low sensitivity. The LV-MaxSonar-EZ1 balances the detection of people with a narrow beam width. Sample results for measured beam patterns are shown below on a 12-inch grid. The detection pattern is shown for; (A) 0.25-inch diameter dowel, note the narrow beam for close small objects, (B) 1-inch diameter dowel, note the long narrow detection pattern, (C) 3.25-inch diameter rod, note the long controlled detection pattern, (D) 11-inch wide board moved left to right with the board parallel to the front sensor face and the sensor stationary. This shows the sensor's range capability.

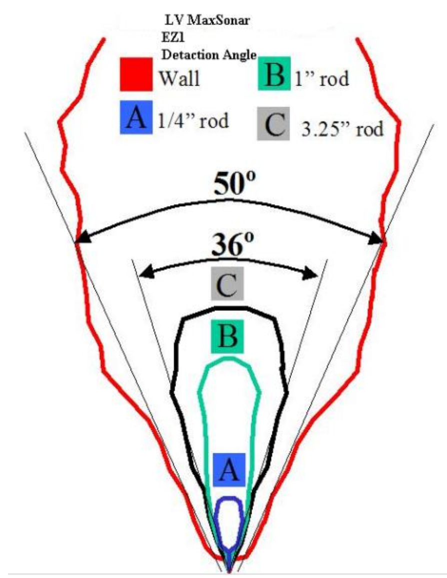

Fig-5: Structure of Beam width

When electrical noise is introduced on the line, it can cause the LV_MaxSonar sensors to output unstable readings. Known items that cause excessive power supply noise are Sharp infrared range sensors, XBee radios, some wireless control systems, some switching power supplies. There is a simple solution that eliminates the effects of a dirty power supply to the sensor. By placing a resistor in series with the V+(input power), along with a 100uF capacitor to ground, you create an effective filter (i.e. almost a placebo battery) for the sensor. This ensures that almost any noise introduced onto the line is captured and only clean stable power is supplied to the sensor. For the circuit connections, please see the schematic below. This connection circuit solves the coming distortion.

5.4 Safely and Security Issues of Humans

Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.

2) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

5.5 Interfacing ultrasonic sensor

In the Real World, a sensor senses any physical parameter and converts into an equivalent analog electrical signal. For efficient and ease of signal processing, this analog signal is converted into a digital signal using an Analog to Digital Converter (ADC).This digital signal is then fed to the Microcontroller (MCU) and is processed accordingly. In general, sensors provide with analog output, but a MCU is a digital one. Hence we need to use ADC. For simple circuits, comparator op-amps can be used. But even this won't be required if we use a MCU. We can straightaway use the inbuilt ADC of the MCU. In ATMEGA16/32, PORT A contains the ADC pins.

5.6 Connecting the ultrasonic sensor with power supply

The ultrasonic sensor is connected to power through the pins Vcc on the sensor.it takes power of maximum 5 voltage .and the GND of the the sensor with GND of the power.after connecting to power the sensor is ready to send data to the other pins as its acquisition maintained in its internal circuit.in order to reduce the distortion comes out side we tried to make it continously charging with power 5 voltage using capacitor of 100 uf and resistor 100 ohm .the capacitor in parrallel with vcc and ground and for the resistor in series with vcc after connecting the capacitor.if the sensor is continously charging with the same power it remove distortion.which means it would have fix value for specific difference instead of having unfixed and different valus of reading of specific distance.

5.7 Connecting the ultrasonic sensor with atmega 16

This sensor mainly feeds analog data through the analog pin for the microcontroller with portA pin 0 and the Gnd of the of the sensor with ground of the port A which pin 9 in the microcontroller.right now the atmega receives the data and process according to the given instruction on it .which receive the data on the bulit in ADC in the controller as input.

In our case our motor is controlled by the relay attached with the microcontroller.first the relay is getting power 12 volt for external power supply. The relay energizes two of it wire from the microcontroller of portB 0 and portB GND . when ever the port B 0 is set and the current flows out through that pin and connect with resistor 1kohm in order to control/reduce the power enter the transitor which is used as a switch .and it get ON or pass power through the emiter and the induced current gets stuck with power because of the magnetic field created around the coiled copper.if there is no any power there will not be any magnetic field created as result it will not connect.

The motor is directly connected to the relay with vcc output and ground of the motor with external power if vcc gets current which means if the relay ON motor gets started runing as result liquid is pumped to the inlet valve of the tanker. If the relay does not gain any power from the microcontroller it is in OFF mode motor will not be running so ,there is no pumping of liquid element to the inlet valve.

The second phase of the system entirely deals with the connection of sites which means controlling area and tanker site interconnection with RF modules (wireless).transmission of data is explicitly needed because manager should have clear image of the tank level.

Transmitter get power form power supply from 3-12 voltage from the power supply through its Vcc pin and grounded to GND pin of the transmitter. The data pin is connected with TX pin of the ultrasonic. For sake of removal of frequency distortion we connect transistor in the transmitter with the pins on the chip. The most determinant pin antenna is connected to the pin ANT and is send to the receivers and received through is antenna.

5.8 Connecting RF receiver to DB-9 (serial port) COM port

RF transmitter send data to receiver and RF receiver receives data through its antenna .RF receiver gets power from the COM port DB -9 of the computer pin of RTS and DTS and GND used to provide power from the computer instead of using another power supply. Each RTS an DTS are connected o a diode 1N4007 in order to control the back flow data to those pin that may damage the computer and those pines are fuzzed together and connected to a resistor 1K ohm to drop 12 volt of these pins to 5 volt and zenor diode of 5.1 to control the flow above 5 volt to ground and feed to the Vcc pin of the receiver and GND pin to ground and data is received through pins 2 Rx. And the data is gained to computer through the selected COM port in the software. On the side of hardware we combine the subsystem-1 and subsystem-2. Subsystem-1 include the data comes from the ultrasonic sensor to RF transmitter through pin TX then the data send through wireless to RF receiver on the computer side through DB9 and the data displayed in the GUI on the computer. Subsystem-2 include the ADC which read data from the ultrasonic sensor which is the data gathered from the tank then the ADC connect to the microcontroller through port A , then the microcontroller send output through port B to switch relay in order to turn ON/OFF the DC motor to control and monitor the tank. At last, we integrate subsystem-1 and subsystem-2, then we are succeeding to integrate the whole system as we were designed at the earlier time.

Algorithm for ATMEGA16

1. Start
2. ADC initialization and channel selection
3. While true
4. Start conversion
5. Wait until end of conversion, then read ADC Value Compare if ADC value is greater than level of the tank)
6. Start motor or set port B equal to 0x01hex.
7. Else stop motor or set port B equal to 0x00hex

6. Results and Discussion

Although there are several different options are available, the most common is where the sensor is screwed into a standard fitting it is attached to the outside of the tanker. The sensor's face or lens is inside and just below the inside surface of tanker. The sensor should be relatively opposite apart from the inlet tube, aiming at the lowest part of the tanker and away from filling source that could be within the beam spread and cause a false echo.

In the domestic water tanker fixed with a small plastic casing on top of the tanker. Casing size is enough to fit an ultrasonic module, RF transmitter, and a 9 volts battery cell with a 5 volts regulator circuit. Regulator circuit provides 5 volts to both ultrasonic module and RF transmitter. Tanker is fixed with two small pipes, one for liquid inlet and other for liquid outlet with two valves. Valves are can be used to control liquid level in tanker manually. A vent is provided on top of the tanker to maintain atmospheric pressure inside the tanker, that is, for exhausting air during liquid filling process as well as for exhausting liquid vapours all the time.

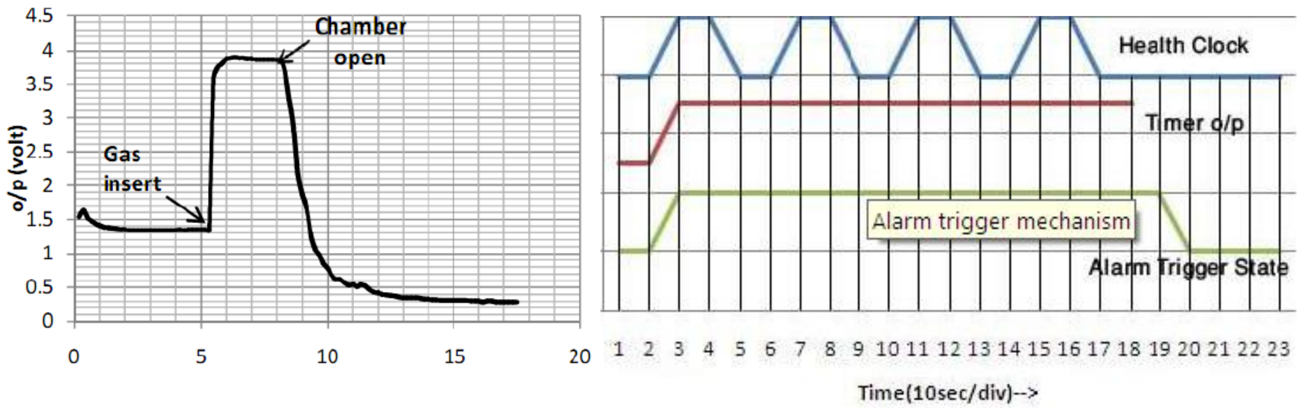

Fig-6: Timing Diagram for Alarm Signal

7. Conclusion and Future Enhancement

The developers of the system can say that a fully operational has been developed. The major cost of the components has been involved. Although the cost of the mass production unit at industry level is relatively low. The point of this research that's comprised the development team, it was very high. The developers have gained valuable experience in hardware interfacing, hardware programming, electronics as well as practical introduction to mechanical design and electronic wiring. For the future enhancement, the manager controls the software on his desire to fill the tank instead of the system on work automatically.

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