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Prevention of Fuel Tank Explosion using PLC

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Abstract: According to a recent case study, it is found that around 25-30% of death due to road accidents are mainly caused by explosion of fuel tanks. Currently Original Equipment Manufacturers are mainly concentrating about the advancement in their automobile technology where limited importance on the safety measures has been considered. Thus the fuel tank has been designed with capabilities that it could avoid explosion by absorbing the fuel at the encounter of an accident within few seconds. The design of fuel tank will be containing a polymer which will come in action at the time of an impact. The whole reaction is triggered by an impact sensor that is currently being used for the air bag safety system. The arrangements will be linked with this impact sensor which will fasten up the response time. The model can be designed according to the need of the automobile manufacturer, ensuring that this process is properly implemented in them. The ratio between the polymer, water and fuel can be standardized according to the capacity of the tank. The impact when sensed by the sensor sends the signal to the PLC and which opens the valve of the polymer and water. Thus, the polymer along with water gets sprayed over the fuel and absorbs the fuel within few seconds, leading to non-combustible form of fuel. We know that the fuel is highly inflammable and explosive but at the end of this process it will have a change in its state leading to non-flammable and incombustible form. These arrangements can play a vital role not only in Automobiles but also in all other Fuel Reservoirs such as Industries, Fuel Station, Defence and Power Plant where it helps in case of natural calamities or any manmade catastrophe.

Keywords: Fuel absorbent, Prevention of explosion, PLC, Automobiles, Reservoirs, Power plant

I. INTRODUCTION

Automobiles at present concentrate on the luxuries, speed but safety features are not up to the level of technological development, where only costly variants of an automobile possess additional safety features apart from standard ones. Most of them are concentrating on the air bags as it is one of the main safety element in the car during an accident. But there are also cases of fuel tank explosion, and our project is all about "Prevention of Fuel tank Explosion". Our main idea is to prevent accidents which are caused due to fuel tank explosion. We have designed a system to overcome the issue of Explosion of Fuel Tank. The sensors used in this system monitors the fuel tank capacity and temperature of the tank and so on, our main motive is to prevent the life loss of the passenger. And there are many drawbacks in the existing safety system in our automobiles, which we modified and redeveloped one of them. In this paper we have various segments such as measuring the temperature of the fuel tank while the engine is ignited and the sensors which monitor the life of fuel tank of the vehicle.

The overall application of this system is wider that it can also be used in Fuel Reservoirs, Oil and Gas Plants, Chemical Industries, Fuel Stations. We collaborate with other innovations in the present such as Earth quake predictors, Flood detectors during our application in Industries Reservoirs, Power Plants. Our design mainly focuses on converting the state of the fuel that is being used. Our system works with any fuel or compound in liquid state where as the chemical composition or the ratio of the chemical and water is to be used accordingly.

II. EXISTING SYSTEM

In the existing system the safety are concentrated only to the minimum level in automobile manufacturing as the people are mainly behind the luxuries, speed and brand. The safety features such as ABS, ESB, Air Bag System, Lane Switch indicators are provided on automobiles not in standard ones but only on costly models. Though these cars possess the above mentioned features but the safety related to fuel tanks are primitive and very minimum that even the costliest vehicle are only provided with guards to avoid physical damage to the tank. But there exists no isolation or safety for the fuel inside the tank. In few automobiles the fuel supply to the engine is blocked so that the vehicle's engine is safeguarded from fire but not the tank. Thus automobiles lack safety to the fuel tanks. The safety features in Industries

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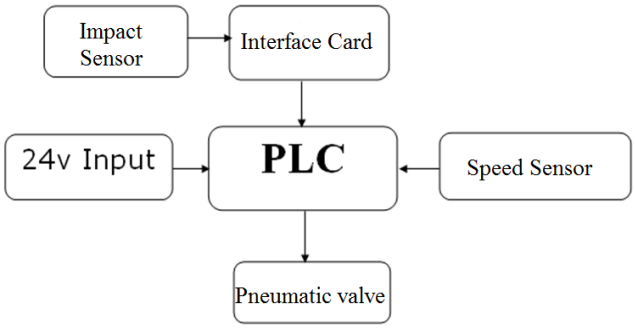
or any fuel reservoirs are up to the level of monitoring the level and temperature within the ambient range but there isn't any safety features to avoid catastrophe except the evacuation of the site. Safety alarms are present in the industrial sites in case of any natural or manmade catastrophe occurs.

III. PROPOSED SYSTEM

In our proposed system, Collision sensors or Impact sensors are placed around the vehicle. They are used as the main sensing element for detecting the collision. The signal from the impact sensors deflates the airbags in Nano seconds. Our system uses the same arrangements in which the impact sensor sends the signal in case of accident and if and only if the impact is greater than the threshold level, signal is sent to the programmable logic controller. The Programmable Logic Controller is coded in such a way that as soon as it gets the signal the PLC opens the valves that hold the Polymer and Water simultaneously. The polymer and water reacts with fuel and turns it into a crystalline solid form. The proper proportion of polymer and water are stored in the valves with respect to the capacity of the fuel tank. The fuel turns to non-flammable state in which it loses its tendency to burn. This occupies approximately 10% of the actual fuel tank's volume. These after products can be cleaned in due course of time. Our arrangements can be implemented in Reservoirs also by designing the reservoirs with and inner and outer tank like structure which works on the same mechanism in case of any natural or manmade catastrophe.



IV. RELATED WORKS

A. SOLENOID VALVE:

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design. Here we use the Solenoid valves to control the flow of the Polymer and Water into the fuel tank with proper timing and ratio in accordance to the place of application.

B. Programmable Logic Controller (PLC):

A Programmable Logic Controller (PLC) or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices, or any activity that requires high reliability, ease of programming and process fault diagnosis. PLCs can range from small modular devices with tens of inputs and outputs (I/O), in a housing integral with the processor, to large rack-mounted modular devices with a count of thousands of I/O, and which are often networked to other PLC and SCADA systems. They can be designed for many arrangements of digital and analog I/O, extended temperature ranges, immunity

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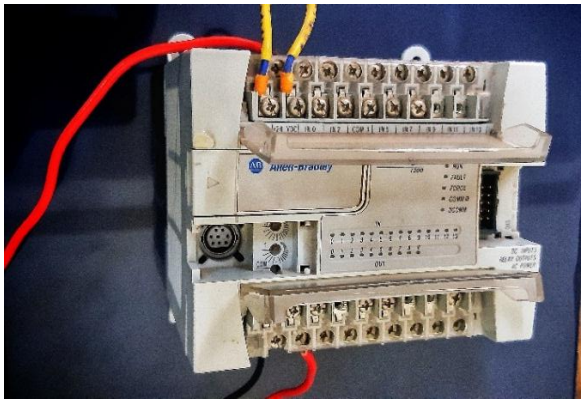
to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. Here we use *Allen Bradley-Rockwell PLC* in order to monitor the sensor's signal. The PLC is programmed in such a way that it opens the valves of polymer and water in less than a second in order to react with the fuel. We use PLC in order control more than one process which are planned in the advancement of the project.



C. **Force Sensor (Or) Pressure Sensor**

Force Sensor or the Force sensing resistor is a material whose resistance changes when a force, pressure or mechanical stress is applied. They are also known as "force-sensitive resistor" and are sometimes referred to as Impact Sensor. Pressure measurements or force measurment are carried out with the help of this sensor. Force sensor also acts as a transducer, it generates signal as a function of pressure imposed. Pressure sensors are used in our daytoday life to control and moniter many applications. Some of them acts as pressure switches which are used to turn on or off at a particular pressure. These are used for various pressure measurements. Pressure sensors are categorized which are absolute, vacum, differential, sealed. Each of them are used for different purposes according to their need. Sensing of pressure or force is carried out with the following technologies capacitive, electromagnetic, piezoelectric, strain gauge, optical, force balancing, resonant, thermal, ionization. Here we use this sensor in order to detect the collision and activate our system if needed. This sensor senses the force of the impact and sends the signal to PLC if the force is grater than threshold level.

D. **Polymer**

The Polymer we use is known for its properties with liquids, it is a sodium salt of an acid with the particular combination of polymers and broad application in consumer products. This Polymer is an anionic polyelectrolyte with negatively charged carboxylic groups in the main chain.

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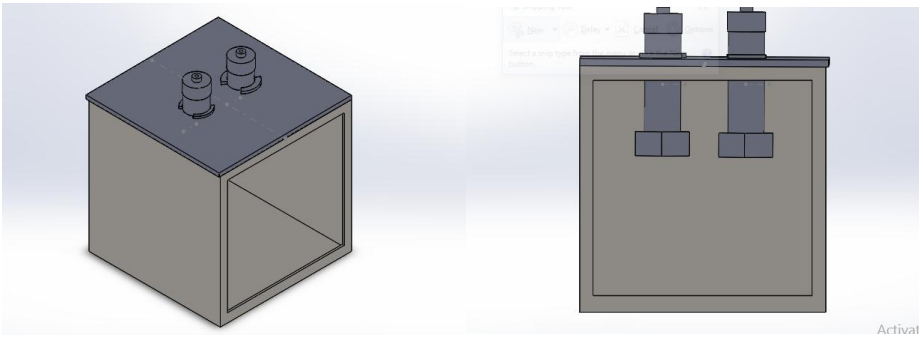
While sodium neutralized poly acids are the most common form used in industry, there are also other salts available including potassium, lithium and ammonium. Here we use this polymer to change the state of the fuel. The reaction of the chemical and fuel turns it to a non-flammable state. The proper proportion of our polymer is to maintained in our sub tanks with respect to the fuel capacity.

E. Prototype Design

In our prototype we have designed a sample tank in which we have provided two subtanks that holds the Polymer and Water. The main tank is to store the fuel. The after product of this arrangement can be cleaned with ease. This arrangement can be implemented in oil storage or fuel storage area where the tank or the storage can be designed in such a way that it has an outer tank and an inner tank. The polymer and water can be placed in the outer layer of the tank separated from water present in that same tank. When required, that is in case of any emergency the valves open and releases the polymer and water to react with any oil stored. Thus avoids the rate of explosions and accidents in Industrial areas.



V. CONCLUSION

The Prevention of Fuel Tank Explosion using PLC is our arrangement from which the life losses due to the explosion of fuel tank can be avoided to the maximum extent. The Automobiles and Reservoirs if provided with our arrangement, the lives can be saved along with all other inventions. This acquires only to 10% of the actual volume of the storage in the current design but it can be reduced in due course of advancement. The industrial setup can be made without any change to the actual volume. The cost of implementation is less than Rs. 100 for an 10L tank. Our arrangement can not only be used to avoid explosion in case of accident but also to avoid the spillage of highly combustible fuel. Thus, Prevention of fuel tank explosion of PLC is a practically applicable arrangement which can be used in many sectors to reduce the loss of lives with less investment on implementation.

REFERENCES

[1]. Ching-Yao Chan, "A treatise on crash sensing for automotive air bag systems," in IEEE/ASME Transactions on Mechatronics, vol. 7, no. 2, pp. 220-234, June 2002.
[2]. K. A. Hammadi, M. Ismaeel and T. Faisal, "Intelligent car safety system," 2016 IEEE Industrial Electronics and Applications Conference (IEACon), Kota Kinabalu, 2016, pp. 319-322.
[3]. R. Sowah et al., "Design and Implementation of a Fire Detection and Control System with Enhanced Security and Safety for Automobiles Using Neuro-Fuzzy Logic," 2018 IEEE 7th International Conference on Adaptive Science & Technology (ICAST), Accra, 2018, pp. 1-8.
[4]. M. E. Hill and L. E. Bechtold, "Protecting aircraft fuel tanks using reliability analysis," 2014 Reliability and Maintainability Symposium, Colorado Springs, CO, 2014, pp. 1-5.
[5]. H. Oman, "Fires And Explosions In Fuel Tanks," in IEEE Aerospace and Electronic Systems Magazine, vol. 13, no. 1, pp. 14-15, Jan. 1998.
[6]. R. Ge, Z. Lu and F. Zhao, "Research of front seat design parameters on rear seat passenger safety," 2013 International Conference on Quality, Reliability, Risk, Maintenance, and Safety Engineering (QR2MSE), Chengdu, 2013, pp. 520-523.