Design and Development of System for Public Safety

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Abstract:
The dictionary describes an accident as "an unexpected and undesirable event" and it describes safety as "free from harm or risk ". There are many ways to reduce accidents: regulations, proper infrastructure, and human behavior and as also many devices to assure safety at various areas. According to a news paper titled The Sunday Guardian , India's rank in global prosperity and well-being index slipped down by 10 spots since last year and one of the major reasons for such a slip is Safety. Safety does play a crucial role and do determine the state of development i.e. developing, developed , under developed, developed nations have very low chances of accidents due to high safety regulation and implementations at various levels . Most of citizens try to be unfettered from the safety rules and regulations; their assumption of being the veterans of safety also creates havoc situations.
key words **:** *PLC, IR sensors, sensors*

"*PREVENTION IS BETTER THAN CURE*"

The above proverb has inspired us to think over safety. Prevention is only possible at an area only when we follow safety measures or standards. Safety at all aspects is necessary - design, operations, regulations, planning, standards, testing, behavioral safety, and across different sectors, such as Fire, Transportation, Consumer, Industrial, Informal Sector, Buildings and Structures. Structures include our old monuments, houses, big apartments and commercial malls.

Introduction:

In our daily life, we come across various situations in our surroundings where we feel strongly that a better safety parameter should be adopted. One of the most non-terminating news that we get to see in the newspaper is "Gas leakages" in every corner of the world; it could be industries, homes any where possible. The Bhopal Gas Plant tragedy that took some 2 decades ago is still influencing the lives of people over there with some unpredictable and incurable diseases. The main objective is to introduce safety at all corners of life i.e. homes, living place. For a safer nation, safety begins from within the day to day practices. So we are trying to propose a safety idea that would decrease the human interference to remarkable level.

Safety at homes : For this safety idea to be more user –beneficial, we have done a survey from the residents of 4-5 apartments and from the feedbacks from over 1.5k residents. We could infer the following were safety parameters which they require :

i. Gas leakage identification system
ii. Power Fluctuation system
iii. Water leakage system
iv. Failure of motor
v. Elevator malfunctioning
vi. Parking Space
vii. Fire Safety
viii. Perimeter Monitoring

Our idea was to monitor all the above eight parameters continuously and indicate it to the required authorities in case of any problem or malfunctions. In most of industries today they use a high speed automation device called PLC i.e. programmable logic controls, it's totally based on operation of logic gates. It works as preprogrammed by the user. We have preferred cause of fast response time of about 100 ms and it's very easy in terms of programming.

PLC Basics

A PLC (i.e. Programmable Logic Controller) is a device that was introduced to replace the necessary sequential relay circuits for machine control. The PLC works by looking at its inputs and depending upon their state, turning on/off its outputs. The user enters a program, usually via software, that gives the desired results.

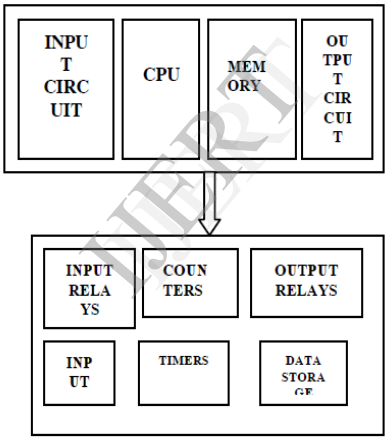
For example: let's assume that when a switch turns on we want to turn a solenoid on for 5 seconds and then turn it off regardless of how long the switch is on for. We can do this with a simple external timer.

The stated example would be complicated when the number of switches and solenoids increase, let's assume if there were 10 switches and solenoids then we would need some 10 external timers. Thereby, making the connections complicated. It would be user oriented if we are able to introduce simple programming, such as PLC that would react according to user in respect to kind of output and time to be taken for the reaction to occur.

From the above example, we can infer that the bigger the process the need for a PLC increases.

Contents of PLC:

The PLC mainly consists of a CPU, memory areas, and internal circuits connections to receive the input/output data. In simple terms PLC can be considered as a box filled with thousands of separate relays, counters, timers and data storage locations. PLC consists of simulated timers, counters, relays which can be actuated through software programming.



Functions:

INPUT RELAYS-These are interfaced from outside. They are connected from outside and have a major function of receiving signals from switches, sensors, etc. Typically they are *not* relays but rather they are transistors.

INTERNAL UTILITY RELAYS- They do not receive signals from the outside world. They are simulated relays and enable a PLC to eliminate external relays. There are also some special relays that are used for proper performing. Some are always on while some are always off. Some are on only once during power-on and are typically used for initializing data that was stored.

COUNTERS- They are simulated counters and they can be programmed to count pulses. These counters can count up, down or both up and down as per user requirement. Since they are simulated they are limited in their counting speed. Some manufacturers also include high-speed counters that are hardware based.

TIMERS- They come in many varied kind of increments. The most common type is an on-delay type. Others include off-delay and both retentive and non-retentive types. Increments vary from "1ms" to "1s".

OUTPUT RELAYS-These are connected to our desired output field. They physically exist and send on/off signals to solenoids, lights, etc. They can be transistors, relays depending upon the model chosen.

DATA STORAGE-There are registers assigned to simply store data. They are usually used as temporary storage for math or data manipulation. They can also typically be used to store data when power is removed from the PLC. Upon power-up they will still have the same contents as before power was removed.

Working of PLC:

A PLC works by continually scanning a program. The scan cycle consists of 3 important steps.

CHECK INPUT STATUS:

First the PLC checks the status of each input to determine it's on/ off condition. It records this data into its memory to be used during the next step.

EXECUTE PROGRAM:

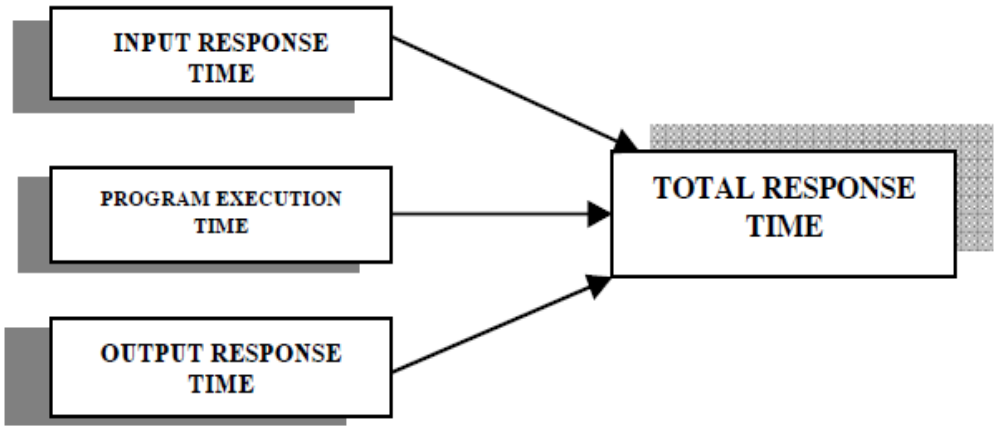
The PLC executes your program one instruction at a time. Maybe your program said that if the first input was on then it should turn on the first output. Since it already knows which inputs are on/off from the previous step it will be able to decide whether the first output should be turned on based on the state of the first input. It will store the execution results for use later during the next step.

UPDATE OUTPUT STATUS:

Finally the PLC updates the status of the outputs. It updates the outputs based on which inputs were on during the first step and the results of executing your program during the second step.One scan time is defined as the time it takes to execute the 3 steps listed above.

Response Time:

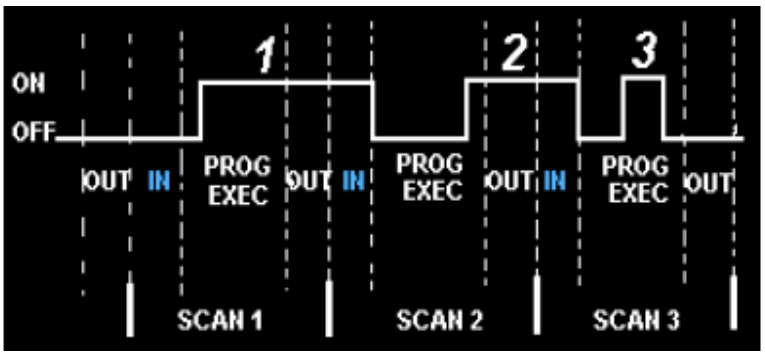
The PLC takes a certain amount of time to react to changes. In many applications speed is not a concern, in others speed does matter a lot. In the example where we see the picture hung on the wall our eyes can be considered the sensor. The eyes are connected to the input circuit of your brain. The input circuit of your brain takes a certain amount of time to realize that our eyes have seen something and starts processing the data. It then sends an output signal to your mouth. Your mouth receives this data and begins to talk something about the hung picture.



Notice in this example we had to respond to 3 things:

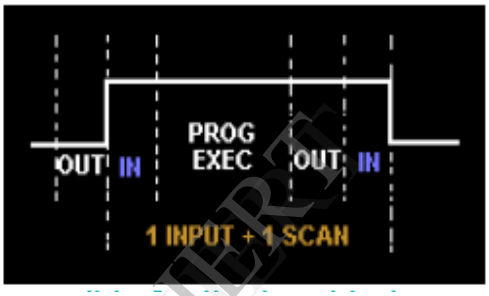
- *INPUT:* It took a certain amount of time for the brain to notice the input signal from the eyes.
- *EXECUTION:* It took a certain amount of time to process the information received from the eyes. Consider the program to be: If the eyes see an ugly picture then output appropriate words to the mouth.
- *OUTPUT:* The mouth receives a signal from the brain and eventually we start talking about the picture.

The PLC can only see an input turn on/off when it is scanning.



diagram(i)

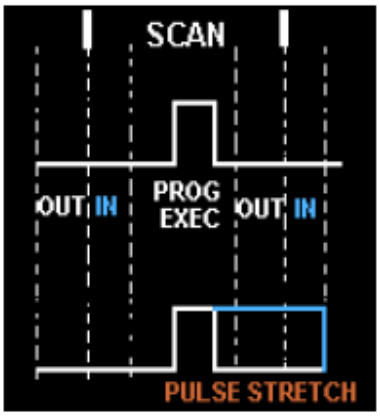
In the diagram, input 1 is not seen until scan 2. This is because when input 1 turned on, scan 1 had already finished looking at the inputs. Input 2 is not seen until scan 3. This is also because when the input turned on scan 2 had already finished looking at the inputs. Input 3 is never seen. This is because when scan 3 was looking at the inputs, signal 3 was not on yet. It turns off before scan 4 looks at the inputs. Therefore signal 3 is never seen by the plc. To avoid this we say that the input should be on for at least 1 input delay time + one scan time.



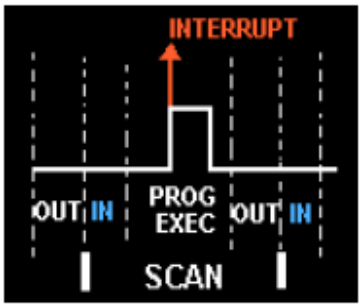
But what if it were not possible for the input to be on this long? Then the PLC doesn't see the input turn on. In such conditions we have two functions

a. Pulse stretch function
b. Interrupt function

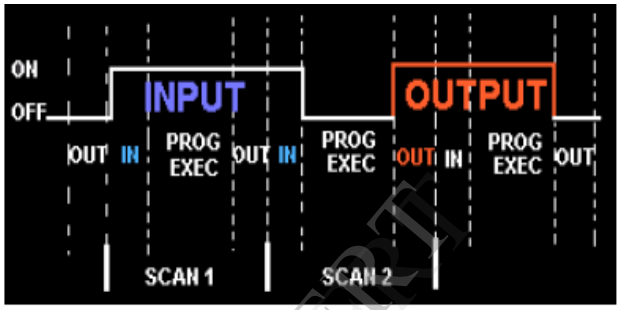
Pulse stretch function: This function extends the length of the input signal until the plc looks at the inputs during the *next* scan. i.e. it stretches the duration of the pulse.



Interrupt function: This function interrupts the scan to process a special routine that you have written. i.e. As soon as the input turns on, regardless of where the scan currently is, the plc immediately stops what its doing and executes an interrupt routine. (A routine can be thought of as a mini program outside of the main program.) After it's done executing the interrupt routine, it goes back to the point it left off at and continues on with the normal scan process.

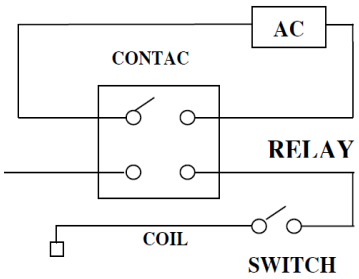


Now let's consider the longest time for an output to actually turn on. Let's assume that when a switch turns on we need to turn on a load connected to the plc output. The diagram below shows the longest delay for the output to turn on after the input has turned on. The maximum delay is thus 2 scan cycles - 1input delay time.



RELAYS:

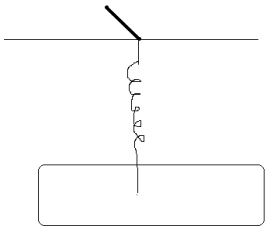
In simple words, a relay can be considered as an electromagnetic switch. Apply a voltage to the coil and a magnetic field is generated. This magnetic field creates the contacts of the relay in causing them to make a connection. These contacts can be considered to be a switch. They allow current to flow between 2 points thereby closing the circuit. Let's consider the following example:



Here we turn on a bell when switch is closed. We have A switch, a relay and a bulb. Whenever the switch closes we apply a current to a bell causing it to sound. Here we are using a DC relay to control an AC circuit. When the switch is open no current can flow through the coil of the relay. As soon as the switch is closed, current runs through the coil causing a magnetic field to build up. This magnetic field causes the contacts of the relay to close. Now AC current flows through the bulb and the bulb glows.

Gas leakage Identification system

As we can see from the diagram, the rectangular shape would act as diaphragm the darker line will act as a switch, hence forth acting like a pressure switch. It is designed that it would be in equilibrium state at normal pressure any change in pressure would lead the misbalance and thereby operating the switch, which would send signal to PLC and further action, can be taken.

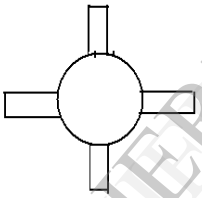


Power Overloading

Many of residents complained of existing method of tripping of MCB in case of overloading stating that tripping has really caused damage to other electrical goods also. So instead of tripping of MCB we can actually indicate the particular home or flat about overloading condition.

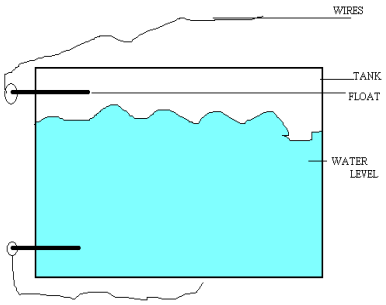
Water Leakage System:

Many of residents have complained about irregular water flow coming and in order to chuck that problem we have thought introducing a water wheel as shown in diagram that rotate at a fixed speed and if only the speed is lower than the threshold the switch is operated actuating a signal to PLC.



Automatic motor ON/OFF

There will be two floats that are placed at low levels and maximum levels so that they actuate the switch according to the water levels. In case of two motor facilities the second motor would switch on if first motor is not operating in 20 seconds.

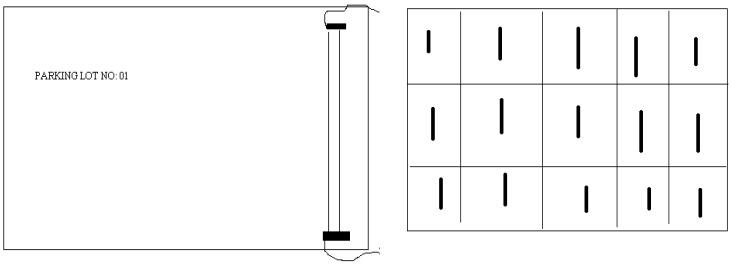


Elevator malfunction

The motor is provided with the shaft, the purpose of shaft is to indicate any cases of lift getting struck between two floors. Every lift comes with a microprocessor; we would program processor such a way that it continuously sends an electric pulse to PLC stating its working condition, in case of failure of message to PLC within seconds the message appears on Engineering Console stating about the malfunction.

Parking Space

The above is setup for parking system, to left is plan at parking lot , the thick lines indicate IR sensors if the vehicle cuts the path of IR then Led will glow at the security end the right diagram shows the LED setup as soon as the all the lights glow a temporary parking gate opens up automatically indicating security person.

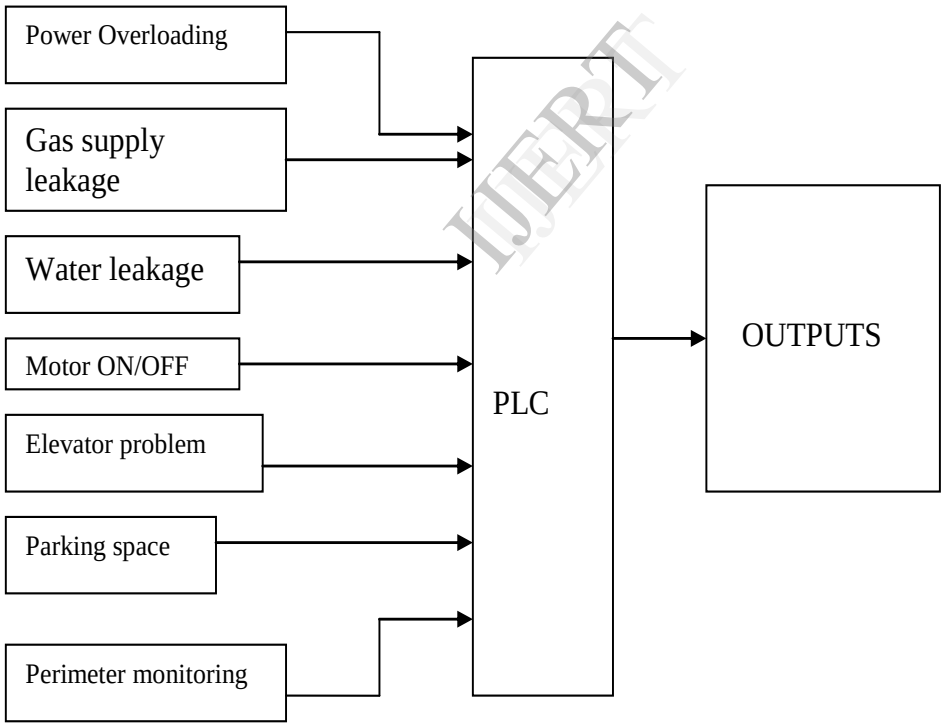


Fire safety

We use ionization smoke detectors that would detect fire and actuate signal to PLC which would inform the local nearby fire brigade to take necessary action.

Perimeter Monitoring

We use same idea that's used for parking in case of signal interruption an alarm snoozes and a message is sent to nearest Police Station.



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