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Automated Instrumentation Panel for Distributive Control System

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Abstract: *Automation is the technology by which a process or procedure is performed with minimum human assistance. Automation or automatic control is the use of various control systems for operating equipments such as machinery, processes in factories, boilers and other applications and vehicles with minimal or reduced human interventions. Automation covers applications ranging from a household thermostat controlling a boiler, to a large industrial control systems with tens of thousands of input measurements and output control systems.*
In the simplest type of an automatic control loop, a controller compares a measured value of a process with a desired set value, and process the resulting error signal to change some input to the process, in such a way that the process stays at its set point despite the disturbances. Automation has been achieved by various means including mechanical, electrical, electronic devices and computers usually in combination.
The control of process parameters in processing of milk and manufacture of different products is one of the essential requirements to achieve desired quality product. In addition to consistency in product quality, automation also provides scope for operational flexibility, energy conservation and safety in the plant.
In industries to control various parameters like voltage, temperature, level and humidity, the entire coding needs to be changed as they are controlled independently. Thus to overcome this complexity we are designing an HMI based instrumentation panel which can be operated easily.

Keywords: *Microcontroller, Human Machine Interface (HMI), LM35 (Temperature sensor), HC-SR04 (Ultrasonic sensor), DHT-11(Humidity sensor)*

I. Introduction

Technological advancement is gradually finding applications in the agricultural and food products, in response to one of the greatest challenges i.e. meeting the need of the growing population. Efforts are being geared up towards the replacement of human operator with automated systems. Automation means every action that is needed to control a process at optimum efficiency as controlled by a system that operates using instructions that have been programmed into it or response to some activities. Automated systems in most cases are faster and more precise.

In industries, there are different knobs (regulators) to control and set the various parameters of the system. Various parameters such as temperature, level, humidity and voltage of the system. When the chemicals in the tank release in the form of gases etc, the level of the liquid changes. The system needs to be continuously monitored as the threshold value needs to be set by the knobs and the parameters are controlled by individual regulators.

Hence, we are developing an HMI based instrumentation panel for operating and controlling the various parameters from a single node. The HMI screen makes it user friendly to operate and reduce the complexity of the system.

Different parameters such as temperature, current flow pressure and humidity etc. can be controlled and monitor using industrial instrumentation panel. An instrumentation panel is a computer simulated machine. From various sensors, the input signals are passed through compensating cables and the output from the panel is connected to the final control element for controlling. For security reasons, safety audio visual alarms and interlocks are provided via PLCs [1].

An instrumentation panel is a serial bus protocol which connects control system to various sensors which is an alternative for conventional multiwire loops. Currently, PLC based system is used in milk industries, in southern parts of India, which is bit expensive and also leads to generation of noise. And also for flushing of milk containers, manually operated systems are used which leads to much more time consumption and also increases the man-power. [2].

In industries, the existing systems contains knobs for controlling and changing the essential parameters, due to which accuracy is not obtained and the efficiency of the system is also affected. Currently, an alarm indicator is employed in the system for the purpose of control and monitoring the whole system. Because of this, human interference is constantly required like closing and opening of valves, breakers and for sending the collected data from various sensors to the remote stations which in turn gives commands to the operating systems. This conventional system does not only ask for a professional to understand the whole system properly, but it also needs a constant monitoring [3].

Fig. 1. Control Panel

However, in this system, the parameters are controlled and monitored through human machine interface (HMI) which is user friendly to operate and the exact values of the parameters can be set easily just with a touch. This system also includes a unique feature that after achieving the set value of the parameters, the relays or switches automatically halt the specific operation of the system. For example, if the set value of the temperature is kept at 140 degrees, then the system will continue heating it until the temperature reaches 140 degrees, after which the heating of the system will be automatically halted so as to achieve the temperature at 140degrees.

In this system we have employed various sensors to sense the information of different parameters. The sensors used are humidity sensor (DHT11), temperature sensor (LM35), the ultrasonic sensor (HC-SR04) and a potential divider network.

a) Humidity Sensor (DHT11):- For the smooth conduction of many manufacturing processes in industries, the humidity sensors are used. These sensors sense the amount of water vapour in the air and send it to the microcontroller to process the data.[4]

Fig. 2. Humidity Sensor (DHT 11)

b) Temperature Sensor (LM35):-LM35 is an integrated temperature sensor. Temperature sensor consists of a semiconductor material whose resistance changes with the change in surrounding temperature. It works on the principle that the output voltage of the sensor is directly proportional to the centigrade temperature of

the surrounding. LM35 is better than any other conventional temperature sensors labelled in degree kelvin because the user does not need to manually convert degree kelvin into degree centigrade [5].

Fig. 3. Temperature Sensor (LM35)

c) Ultrasonic Sensor (HC-SR04): - Ultrasonic sensors are transducer that convert ultrasonic wave to electric signal and vice versa. Many ultrasonic sensor work as both transceivers because they can both sense and transmit at the same time. The working principle is that the transducers used in radar systems evaluate attributes of a target by interpreting the echoes from radio waves. These sensors generate high frequency sound waves and evaluate the echo which is received by the sensor. The time taken by the signal to bounce back from the target to the sensor gives the estimate of the distance between the target and the ultrasonic sensor. [4].

Fig. 4. Ultrasonic Sensor (HC-SR04)

II. Methodology

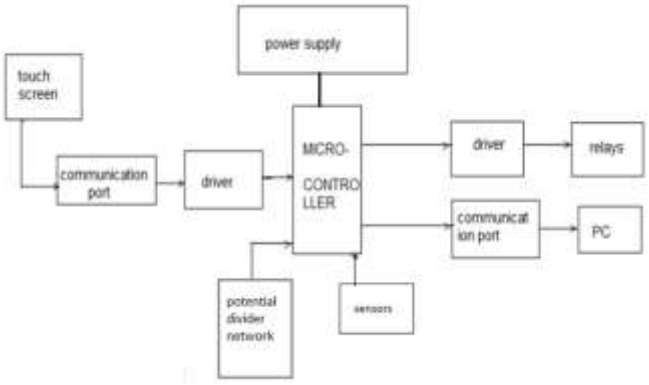

Fig. 5. Block diagram of Automated Instrumentation Panel

A Human Machine Interface (HMI) in the form of Touch Screen would provide a visual representation of different parameters like voltage, temperature, level of the liquid and humidity and also provide real time data acquisition. This can be achieved using a network of various sensors. Communication port will be used for transmitting and receiving data from HMI to microcontroller. Relays will be used as a switch, and will pick up the signal form the microcontroller.

Driver IC will be used here as an amplifier, to amplify the signal before sending it to relays. An additional computer will also be connected to the microcontroller through communication port, just for the sake

of checking the connections in case there is any problem with the touch screen module. AC power supply between the ranges of 220-300 V will be supplied to the microcontroller but, since the microcontroller operates only between 0-5 V, we will use a voltage regulator network to drop down the voltage level. The system works on digital signals.

The sensors will pick up the necessary data from the surrounding and will send it to the microcontroller, which will later on drive the relays to switch ON or OFF certain parameters. The user can directly adjust the values of desired parameters just with a touch on the HMI module.

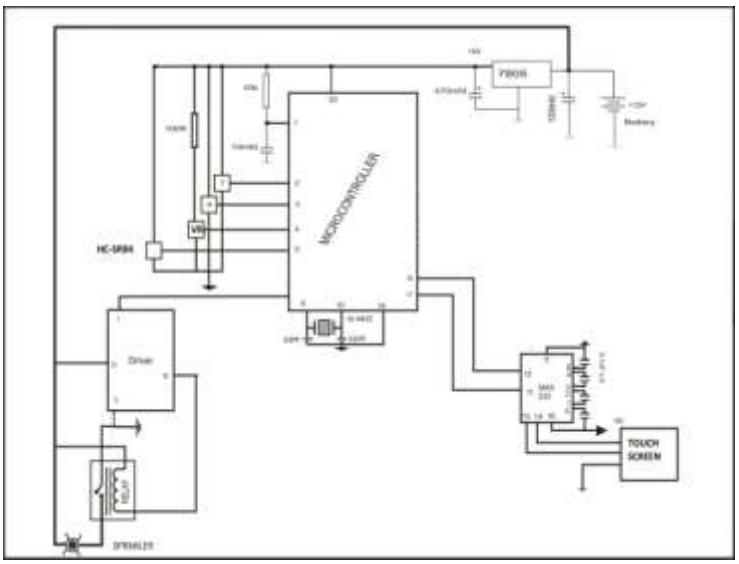

Fig. 6. Circuit diagram of Automated Instrumentation Panel

A 12V supply (with 1000uF capacitor) is provided to the circuit containing a 7805 regulator IC with an input voltage of 5V to all the sensors. The 10Kohm resistor and 10mfd forms the microcontroller power on reset circuit so that when power is on, all values should be zero. The temperature sensor LM35, humidity sensor DHT11, voltage divider network and ultrasonic sensor requires 5V and their o/p is given to microcontroller.
The driver IC used to drive load or relay requires 12V and microcontroller maximum value is 5V. So, driver IC will amplify the 5V signal to 12V signal. A 16MHz crystal oscillator is used to provide clock pulses. 2 capacitors of 33pf are used to maintain duty cycle of clock pulses.

Touch screen can be RS232 or TTL compatible. If RS232 compatible is used then it is according to standard of P.C. where logic 0 means '12V' and logic 1 means '-12 V' whereas for TTL, logic 0 means '0V'and logic 1 means '5V'.If o/p is RS232 compatible, we use an IC to convert RS232 logic to TTL and vice-versa because if RS232 (12V) is given it can cause damage to system.

III. Result

1. We have successfully designed an automated instrumentation panel which provides ease in controlling different parameters effectively and handling the system properly.
2. The complexity of the system is reduced and hence it would be easier for anybody to operate it.

IV. Conclusion And Future Scope

1. An HMI based instrumentation panel reduces human efforts and consumption of time.
2. It is user friendly as just with the help of a touch one can control various parameters effectively instead of the complicated knobs (regulators) system.
3. It increases accuracy, flexibility and stability of the system.
4. With the advanced technologies, automation can attain efficient production and manufacturing processes.

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