

4 Window Annunciator Using ST Microcontroller

Gemshy.S.B¹, Indduja.K², Jenifer.R³ and Somasundaram.R⁴

U.G. Scholar, Department of ECE, Adhiyamaan College of Engineering, Hosur, TN, India^{1,2,3}

Assistant Professor, Department of ECE, Adhiyamaan College of Engineering, Hosur, TN, India.⁴

ABSTRACT: The embedded system is designed for the need of the electrical operator facing challenges in the substation. In this proposed system an alarm annunciator is introduced to analyze the system in the substation. The system detects a fault from the substation and sends an alarm to the operator through the 4 windows LED's. As a prototype of this system the annunciator collects the data from the microcontroller and analyzes the faults, and alerts automatically. The alarm annunciator enables various problems in the substation and servers with the minimum effort and expense.

KEYWORDS: Annunciator, Transistor array, ST microcontroller.

I. INTRODUCTION

In any industry, there are certain device parameters that have to be constantly monitored to ensure the smooth functioning of the machines and safety of the workers. This data is fed to a centralized station where a technician keeps a watch and notifies the subordinates in case of any emergency or malfunctioning. As mentioned in the abstract, an annunciator is a vital part of any process industry, substation or an automated plant, as it allows the maintenance engineer to remotely monitor the condition of currently ongoing processes. As annunciating system is being used in the substation the maintenance engineer does not have to go to each and every machine or device to monitor its vital stats like temperature, pressure, speed, etc. It is used in Electrical Distribution Substation to indicate the site issues, Aircraft feature for Master Warning and Master Caution and Process Control Plants like Water treatment plant, Cement industries, Pipe industries, Synthetic industries, Steel Industries, etc.,

II. RELATED WORK

S. Madhura, Raghumata, M. Poojalakshmi and S. Shreeyas Pravin focuses on Microcontroller and advanced embedded software based product to get the alarm at the control room. When the vibration level is high in Cooling Fan mounted at the Cooling tower of the Thermal power plant, vibration switches are operated which is sensed by the Transmitter. The transmitter will transmit the signal in the form of Messages to the Receiver, which gives the audio & visual Indications at control room and also a Message to the concerned officer.

Shashwat Shukla, Adhivaraganatham Venkatesan, Nithya Venkatesan, R. Dheenadhayalan and Reena Monica. In this paper an Integrated Alarm Annunciation System (AAS) in a Nuclear Power Plant (NPP) is an electronic unit which receives alarm signals from various plant control systems, receives operator inputs and controls the windows as per a standard alarm sequence. The AAS is located in the control room. In Fast Breeder Reactor (FBR), AAS receives alarm signals from plant control systems in the form of potential free digital input contacts. Important safety systems directly issue potential free contact signals to the AAS. However, less significant systems raise alarms in the form of Ethernet packets and are converted into digital signals using a separate Alarm Generation System (AGS). This segregation is used, to maintain high reliability of important systems as well as to reduce cabling in the case of less significant systems. The important aspect in the design

is that any failure in the module receiving Ethernet packets has no effect on the module which receives the potential free contacts. The AAS is CPLD based. The system also has additional features like driving text to LCD/LED screens for operator information along with the Alarm log window. The AGS also have a built in self testing (BIST) feature to periodically test the healthiness of the system and indications for failures. The significance of this system focuses entirely on FBR control rooms.

III. SYSTEM DESCRIPTION

3.1. ST Microcontroller

The STM32L476xx devices are the ultra-low-power microcontrollers based on the high-performance ARM® Cortex®-M4 32-bit RISC core operating at a frequency of up to 80 MHz. The Cortex-M4 core features a Floating-point unit (FPU) single precision which supports all ARM single-precision data-processing instructions and data types. The STM32L476xx devices embed high-speed memories (Flash memory up to 1 Mbyte, up to 128 Kilobyte of SRAM), a flexible external memory controller (FSMC) for static memories, a Quad SPI flash memories interface and an extensive range of enhanced I/Os and peripherals connected to two APB buses, two AHB buses and a 32-bit multi-AHB bus matrix.



Fig 1 ST Microcontroller Board

The devices offer up to three fast 12-bit ADCs (5 Msps), two comparators, two operational amplifiers, two DAC channels, an internal voltage reference buffer, a low-power RTC, two general-purpose 32-bit timer, two 16-bit PWM timers dedicated to motor control, seven general-purpose 16-bit timers, and two 16-bit low-power timers.

3.2. Annunciator

Annunciator plays a vital role in immediate fault recognition by providing instant visual and audible alarms as per the particular selected program sequence. The base unit of alarm annunciator has three programmable keys namely Test, Acknowledge/Accept and Reset keys. Test key helps to perform the complete test of the system. Accept key is used to accept the fault condition. Reset key enables to reset the alarm annunciator to its default state. The LED can be cleared by pressing the Reset button.

3.3. Transistor Array

The ULN2803A device is a 50 V, 500 mA Darlington transistor arrays. The device consists of eight NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of each Darlington pair is 500 mA. The Darlington pairs may be connected in parallel for higher current capability. The SMT32L476xx STM32L476xx devices embed several protection mechanisms for embedded Flash memory and SRAM: readout protection, write protection, proprietary code readout protection and Firewall. The ULN2803A is comprised of eight high voltage, high current NPN Darlington transistor pairs. All units feature a common emitter and open collector outputs. To maximize their effectiveness, these units contain suppression diodes for inductive loads. Each channel of ULN2803A consists of Darlington connected NPN transistors.

3.4. Switch Mode Power Supply

The electronic power supply integrated with the switching regulator for converting the electrical power efficiently from one form to another form with desired characteristics is called as switch –mode power supply. It

is used to obtain regulated DC output voltage from unregulated AC or DC input voltage. Fly back converter type topology is used. It is very simple with very low output power of less than 100W. The unregulated input voltage with a constant magnitude is converted into a desired output voltage by fast switching using a MOSFET; the switching frequency is around 100KHz.

IV. WORKING PRINCIPLE

The Annunciator is integrated with the ST microcontroller where the power supply is given from the SMPS to the microcontroller. This has 4 digital inputs, 3 keys & 4 LED windows as digital outputs. The microcontroller scans digital input based on event interrupt signal and alerts the operator through LED windows. The system is powered by fly back topology SMPS.

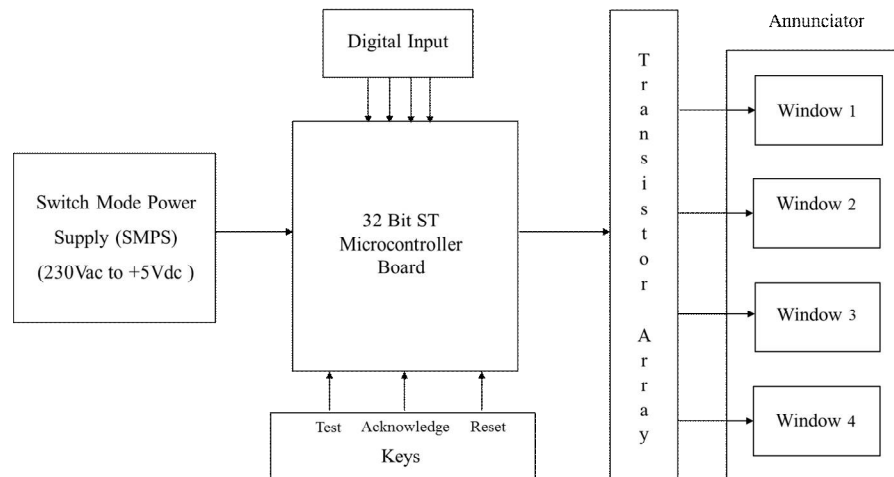


Fig 2 Block Diagram

Whenever there is a change of input contacts from normally open to close or from normally close to open position, annunciator changes from rest condition to alarm condition. Hence there is an immediate recognition of fault input which will have a corresponding visual and audio alarm as per the particular selected program sequence.

V. EXPERIMENTAL RESULTS

In Normal / Healthy Condition, the digital output and LED windows of the system remains LOW & OFF state respectively. In Faulty Condition, the digital input of faulty section should become high state and the corresponding digital output operates and LED window should blink respectively.

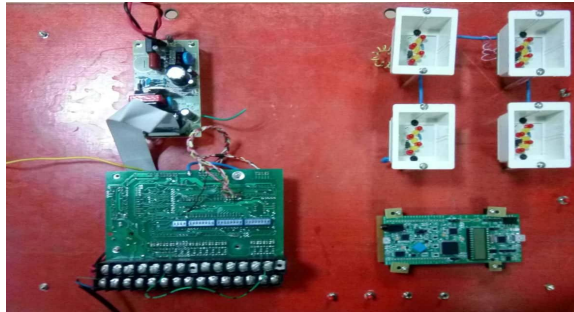


Fig 3 Experimental setup

The operator acknowledges the fault by using ACK. Key, the digital output goes low and LED goes high from blinking state. It should not accept to reset the system under fault condition. Finally, after restored Condition, the operator presses the reset key to reset the LED and the system goes to normal state.

VI. CONCLUSION

In this paper, we have successfully developed an annunciating system which senses or receives the fault from the electrical substations and display an alarm to the operator through the four window LED's. This system overcomes all the major drawbacks of currently used annunciators like lack of reconfigurability and analog inputs. These systems have been made by keeping in mind back compatibility so it's easy to replace them with current systems. The overall expenditure on the development is only a fraction of the costs of current systems.

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