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Digital Control for Three Phase Servo Stabilizer

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Abstract - This paper proposes the design and implementation of Digital Control For Three Phase Servo Stabilizer servo controlled voltage stabilizer in an industrial project. Since the voltage fluctuation comes in the power system, there are many problems developed in the line voltage like distortion, fluctuation, heating, noising, accuracy, power rating, voltage range (230+5%) and power capacity less than 600 VA. To remove these problems, we use voltage stabilizer before the equipment for protection. Mainly two types of stabilizers are present in the market world, one is automatic/line voltage stabilizer and other is (analog and digital) servo voltage controlled stabilizer/regulator. The proposed architecture consists of centralized control unit and distributed control unit. Centralized control communicates with distributed control via I2C communication. In case of failure of centralized control distributed control work. As a result when voltage is low or high servo motor adjust the wiper and gives constant voltage at the output to the set point provided.

1. INTRODUCTION

In modern days industrial devices are mostly based on electronic. Excessive voltage variations are highly dangerous for the sophisticated electrical and electronic equipment such as electro-medical equipment, computers, communication equipment and systems, process controllers, etc. The fluctuations in incoming voltage destroy the life and performance of all type of electrical appliances. There is different voltage requirement for different electrical appliances [1]. The voltage stabilizer is a device to regulate or stabilize voltage automatically that is to take a constant voltage level [2].There are two way to regulate the voltage that is manual control and automatic control. Manual control consists of connecting the voltmeter at the output. Voltmeter senses the output voltage and human being take the decision to correct the voltage by changing the tap of autotransformer. This method is not feasible because of various factors and accuracy[3].Multiprocessor communication system for three phase servo stabilizer consist of one master control card and three slaves control card. Master controller communicates with slave controller through I2C communication.I2C communication is used because it require only two lines for communication with two or more peripherals [4]. The outline of the paper is as follows. Section 2, describes about the methods. Section 3, discuss the performance result. Section 4, concludes the paper.

2. Methods

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To overcome the drawback of unbalance in the voltage level stabilizers are used. The digitally controlled servo stabilizer gives more accuracy and controlled output voltage.

Principle of Servo Stabilizer:

Servo stabilizers compare the output voltage with inbuilt reference voltage. The solid state control circuit operates the motor whenever output voltage falls or rise beyond the pre-set value.

A. Analog control

The analog control card for existing servo stabilizer is used. It consists of comparator IC like LM324 which consist of only four comparators. This can compare four fixed values of voltages with coming voltage which is sensed by sensing transformer [5].

This IC compares only four parameters, if we have to compare extra one parameter then hardware increases. This is the one drawback of analog control card. Another is it consist of fixed resistance voltage divider Circuitry that's why we can't

change the limits of parameters (set point, upper limit, lower limit, and span) manually.

B. Digital control

- System Features:

Start delay:-When the system is switch on within that time output must adjust to set point.

Trip delay:-When the output is touching to upper or lower limit the system must trip after some delay or trip delay [6].

Inbuilt comparator:-To compare the voltage.

Example: Consider the lower limit range is from 300 to 400V. Set point range is from 410 to 445V. Upper limit range is from 455 to 475V. In between this limit we can set the set point, upper limit, lower limit.

Consider our upper limit is 475 V, set point is 430 V, span we take +5V and -5V and lower limit is 365V. As shown in figure if the voltage goes above 475V and goes bellow 365V then our system is in trip. If the voltage is greater than set point+ span the motor is rotating in anticlockwise direction and if the voltage is less than set point – span then the motor is rotating clockwise direction. If the voltage is in between set point + span and set point – span then the motor is not rotating.

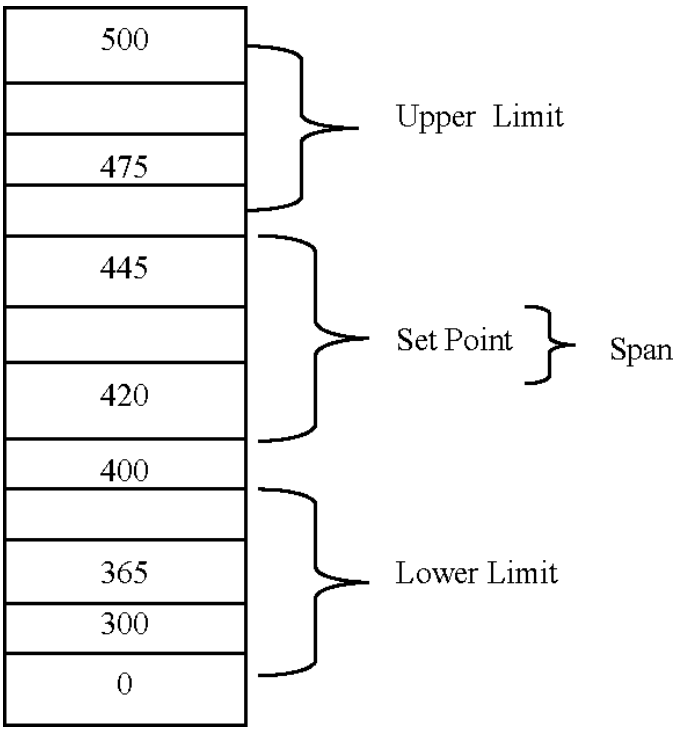

Fig.1. Voltage windows of desired limits

- **Proposed block diagram:**

The system will have master controller having facilities of human machine interface and interconnectivity with slave control units. The slaves will be having capability of working with commands given by masters over shared bus. In case of bus failure slaves can control each phase with predefined local settings.

It is coupled to the variable autotransformer through the shaft and rotate it according to signal received from control circuit

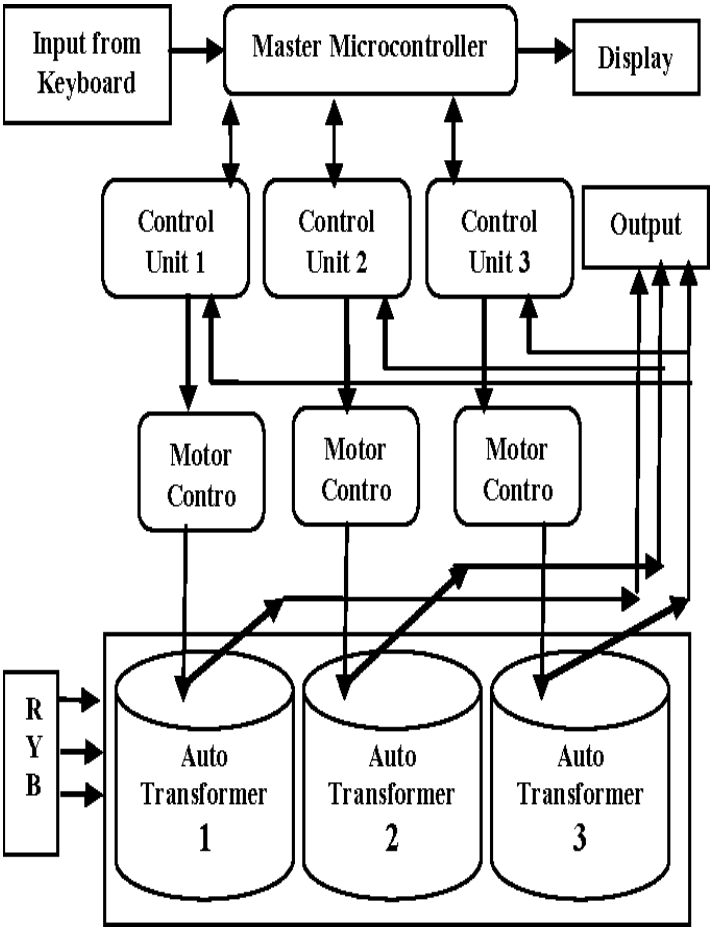

Fig. 2. Block diagram of proposed system

A. Auto Transformer

Autotransformer is an electrical transformer with single winding. On each end of the transformer core is an end terminal for the winding, and second winding is connected to intermediary point, forming a third terminal. Servo motor adjust the wiper of autotransformer to give constant voltage at the output side.

Fig. 3. Autotransformer

B. Motor Control

It consists of driver circuit to drive the AC servo motor. Driver Circuitry is used to drive the servo ac motor. For that it uses Optocoupler (MOC3021) and TRIAC (BT 136).Optocoupler or opto-isolator is combination of LED and light sensitive device. MOC 3021 is an Optocoupler designed for triggering TRIACS. It is non-zero Optocoupler means we can trigger them anywhere in the cycle.

C. Control unit

Control card consist of PIC 16f877A microcontroller .Four A ADC are used for upper limit, lower limit, set point and span. LED are interfaced as an indicator to check condition of voltage windows.

D. Input Keyboard

Input keyboard is interfaced to the master microcontroller to give the upper limit, set point, lower limit and span. Four keys are used to enter the value. First switch is used to enter the value. Second switch increment the value. Third switch is used for decrement the value and fourth switch is used for saving the entered value into the EEPROM.

E. Master Microcontroller

Input keyboard and LCD display are interfaced to the master microcontroller. All the required limits of set point, Upper limit, set point and span are entered to the master microcontroller. Master microcontroller communicates with slave device through I2C communication. It checks whether entered parameter matches to the incoming voltage value. If both are same then control is given to the motor.

F. Display unit

Display unit is used to display the output voltages to the user

Fig. 4. LCD Display

3. CONCLUSIONS

The proposed system i.e. digitally controlled servo stabilizer gives controlled output voltage means which value is entered by user. User can modify the expected value of voltage limits like Set point, Upper limit, Lower limit and span with the help of input keyboard and voltage limits are displayed on LCD. The voltage values saved in EEPROM remains same even after power failure. In case of lower as well as higher input voltage applied, at output the system automatically adjust the wiper of autotransformer (dimmer) in such way that the output always remains at the set point and whichever output voltage we get at load, same is displayed on LCD . If the input crosses lower and upper limit system gets tripped

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