# PIA Technique for Control of Multiple Motors Using Single Starters

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***Abstract-*** **A system has been developed with the combination of Integrated Circuits (ICs) and AC controllers as a multiple motor control. This sophisticated system employs a single starter for various ratings of motor. The software algorithm controls the overall functioning of the starter. Predictive Artificial Intelligence technique is used which helps monitor motor related parameters and take necessary steps autonomously during the abnormal state.**

***Index Terms-*** **Predictive Artificial Intelligence, Pic Microcontroller, Relays, Starters, Current transformer, Potential transformer.**

## I. INTRODUCTION

Electric motors play a vital role in major applications. From very large works to much smaller ones motors are used. Every motor has its own characteristic feature. Motor generally operates in either Direct Current (DC) or Alternating current (AC). With this varying characteristics each motor requires a starter for its operation.

A starter is needed for smooth and optimal operation of the motor. During the initial starting condition back emf ($E_b$) is zero making the armature current very large. The essential need for use of starter is to limit the initial high current.

A motor starter unit has four basic functions: -

1. Isolating the load from mains
2. Protection against short-circuits
3. Protection against overload
4. Commutation or control (start - stop).

Each motor starter unit can be enhanced with additional functions depending on its purpose. These can be:

1. Power: speed controller, soft starter, phase reversal, etc.
2. Checking: auxiliary contacts, time-delay, communication, etc.

DC motors are relatively easier to control compared to the AC motors. Hence the big deal is with controlling the AC motors and AC motors find its application in various industries. Commonly used Ac motor starters are – Auto Transformer starter, Star – Delta starter, Stator Resistance starter, Direct On-Line starter (DoL), Soft starter.

**Main Features of the project:**

- Automatic low and high voltage detection.
- Automatic over current detection.
- Report for reason for failure of machines.
- Recording the motor related parameters on real time.

Industrial application demands multiple motors to operate at a particular time. When many number of motors operate a, the control and monitoring of the motors becomes difficult. This problem persists in almost every industry that uses very large AC motors. Various motor parameters needs to be monitored, with the most fundamental being current and voltage. Adding to this different types and various rating motors are used based on the application. Each of these motors require a specifically designed starter for its specification.

This need for specific starter for different rating of motors can be satisfied using the proposed system. Thus in this developed system, an advanced starter system has been devised which can be utilized irrespective of the rating and type of motor. This multiple starter system has been developed with industrial grade following all the electrical and mechanical standards. It was specifically designed for industrial use, offering ease of control and efficient operation of the motor. Every operation and control of motors has to be run upon a specific algorithm. Algorithms specify the overall working of the starter. Predictive Artificial Intelligence has been employed

here which offers much more advantage compared to the conventional closed loop control or PID control.
A real relay is used as a starter to switch single phase motor; if necessary it can use switch-gear to operate 3φ motor without any change in acquiring, monitoring and relay circuits of electronics or electrical. Up to four motors can be switched at a time or one by one or whatever the way the user need

## II. ARTIFICIAL INTELLIGENCE

Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment.
Artificial Intelligence play a very important role in the starter. Numerous techniques can be employed for optimizing and controlling the motor. But every techniques has its own drawbacks. Predictive Artificial Intelligence proves to be the most appropriate choice for controlling the motor. This technique is rather simple to code and provides sophisticated control with ease.

### A. Predictive Artificial Intelligence

It is mainly used as sensor data analytics for predictive maintenance. It's works based on the specific set of values given to it, which acts as the threshold values for various parameters. This technique when applied to a system provides a much higher level of protection and optimization of various parameters. Its Prediction algorithm helps foresee the problems which can arise due to any violation in electrical parameters.
This algorithm play a vital role in the developed system from starting the motor to controlling it during the abnormal situations. Its decisive nature helps control the motor indigenously, providing the real time data in a graphical format.

## III. FUNCTIONS OF MOTOR STARTER UNITS

❖ Isolating contacts

Isolating contacts are compulsory and must be fitted at the head of all circuits (cf. installation standards NF C15-100, IEC 60364-5-53), they are not compulsory but recommended for each motor starter unit. Their role is to insulate circuits safely from their energy source (mains power supply) to ensure the protection of goods and people if there is maintenance work, reparation work, or alterations to electric circuits downstream

❖ Protection

- Protection against short-circuits

It is necessary to detect the overcurrent following the short circuits (generally more than 10 times the rated current) and open the faulty circuit. It is filled with fuses or magnetic circuit breakers.

- Protection against overload

For this it is necessary to detect the overcurrent following the overload and open the faulty circuit. It is filled with electromechanical or electronic devices (overload relay) linked to a breaking device (a circuit breaker or contactor) or built into the starters or electronic speed controllers. It also protects the motor line against thermal overload.

❖ Commutation or control

The control function can be ensured by a load break switch or by motor starting device, soft starters or speed controllers. But a contactor is mostly used to carry out this function as it allows for remote control. With motors, this control device must allow for a large number of operations (electrical durability) and must comply with standards IEC 60947-4-1.

## IV. PROPOSED SOLUTION

The Proposed Solution is based on predictive intelligence analysis which is used in controlling motors autonomously during abnormal state. This analysis is based on the predetermined values of motor parameters. Software is used to control the motor by giving the control action in the program.

## V.HARDWARE IMPLEMENTATION

In this system PIC16F877A microcontroller is used which is a 40-pin dual inline package IC. This microcontroller has an inbuilt 10 bit ADC and 4K x 14 words of Program Memory (EPROM) 256 x 8 bytes of Data Memory (RAM). Thermistors are resistors whose value changes with respect to small change in temperature. The value of operating temperature of motor is given and any violation in operating temperature will result in motor tripping.

Relays are used to trip the motor from supply when voltage or current becomes high.

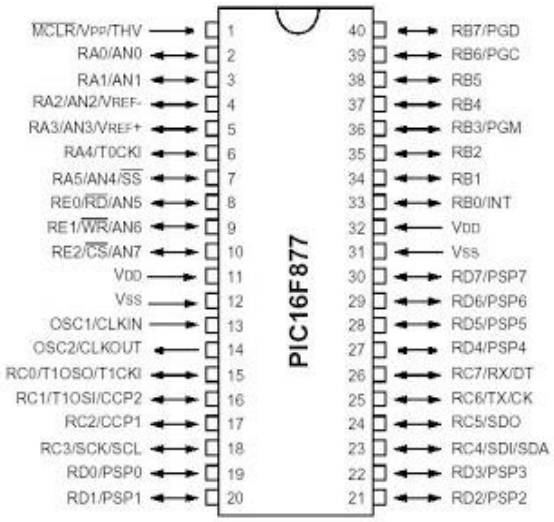


Figure. (1)

The PIN diagram of PIC16F877A is given in Figure.(1) and it has five ports namely A,B,C, D, E. Port A and E have both analog and digital input and output. Port B, C, D have only digital input and output. Light intensity detector are used. To avoid human intervention we go for automatic lighting system which senses light luminescence and depending upon the light intensity the lighting systems are switched on .A powerful and sensitive "LDR" (Light Dependent Resistor) is used for the light detection. Instruments transformers are used for measurement and control of AC circuits. It protects the operator, measuring device and control equipment's from high voltage. There are two types of instrument transformer namely, potential transformer and current transformer. The potential transformer operates on the same principle as a power or distribution transformer. The main difference is that the capacity of a potential transformer has ratings from 100 to 500 volt amperes (VA). The low voltage side is usually wound for 115 V. The load on the low voltage side consists of potential coils of various instruments, relays and other control equipment. In general the load is relatively low and it is not necessary to have PT with a capacity greater than 100 to 500 VA.

The high voltage primary winding of a PT has the same voltage rating as the primary circuit. The voltmeter is calibrated to indicate the actual value of voltage on the primary side. As a result, the possibility of error is reduced

## VI SOFTWARE AND TESTING

The system testing is done in two ways namely (i) Hardware testing, (ii) software testing. Hardware testing is done by multimeter and testing programs. Hardware problem may depend upon electrical parameters like voltage and current. Software testing is done by trial and error method that is software is developed and tested if error occurs it is then modified.

SCREEN OUTPUT

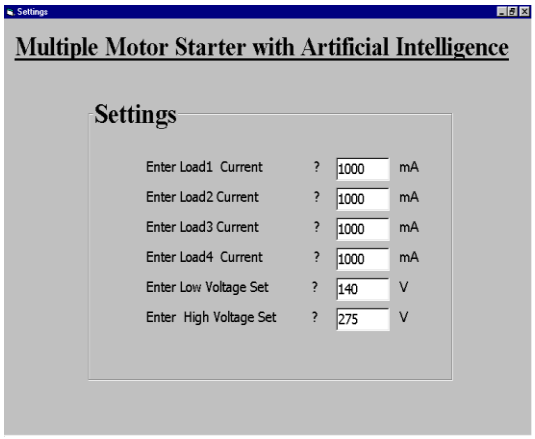


Figure. (2)

The Figure.(2) gives the form in which we set the value of current for each load and the minimum and maximum limit of voltage. This page is linked to the next page displaying the load currents, voltages and the other things. This page has the options of controlling the loads, that is on and off condition.

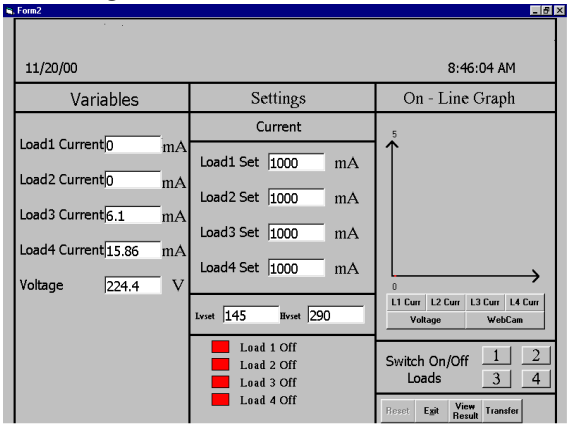


Figure.(3)

The Figure.(3) shows that, right end has the graph facility for each load's current separately as well as voltage graph is available. If the loads are tripped then the load current graph goes downwards to zero. If the loads are in working condition then it is indicated in green color. If it is switched off then it is indicated by red color and if it tripped then it is indicated by violet color in the small box provided for the status of the load.

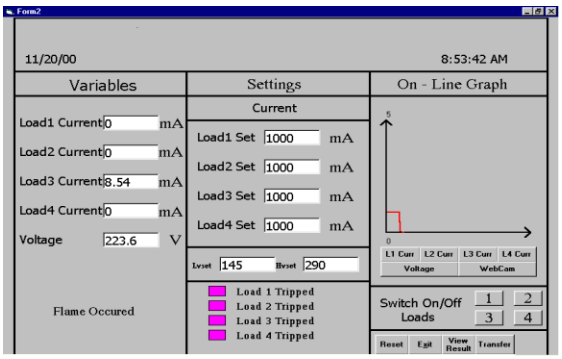


Figure. (4)

If the records are to be seen, then click the view result button that contains the record this can be seen in Figure. (4). The database is created with the help of MS-ACCESS and it contains the values of load current with date and time with a new page.

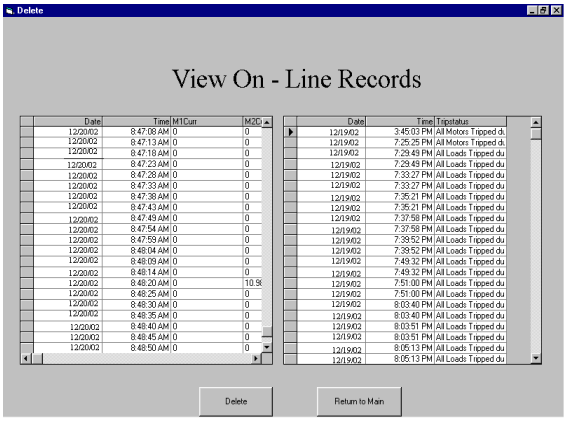


Figure. (5)

The reset button is provided which is used to restart the operations. This is directly linked to the main page. If we reset the operation then we have to enter the new values in the settings. The exit button is also provided, which is used to exit from the program. The Figure. (5) shows the line records and reason for trip of motor and it also shows delete option to clear the records.

## VII FUTURE SCOPE

- Controlling the devices via Internet.
- Possible use of optical fiber cables.
- Wireless interconnection of computers.
- Introduce WAP technology.

## VIII CONCLUSION

Using PIA technique, we can determine the value of motor parameters and we can prevent the motor from high current and voltage and it can also be prevented from high temperature using thermistors. Using this method we can control the motor i.e turning ON and OFF from a certain distance and it also uses a remote for controlling the motor rather than monitoring by standing close to the motor.

## REFERENCE

[1] https://www.schneiderelectric.hu/documents/automation-and-control/asg-5-motor-starters.pdf
[2] https://www.electronicshub.org/what-is-motor-starter
[3] http://sites.tcs.com/blogs/research-and innovation/role-of-artificial-intelligence-in-predictive-analysis-using-sensor-data
[4] The Quest for Artificial Intelligence - https://ai.stanford.edu/~nilsson/QAI/qai.pdf
[5] Akayleh, A.S., Addasi, E.S., Al-Jufout, S.A. (2016) „Speed Control of Multiple Induction Motors of Electromagnetic Shaft Synchronization System", Power and Energy (PECon), Melaka, pp.781-785.
[6] Arefeen, M.S., Figoli, D., Zhenyu Yu, (1999) „Integrating Multiple Motor Control Functions Using a Single Dsp Controller", APEC 99", Vol.2, pp.813-818.
[7] Chao-Ting Chu, Huann-Keng Chiang, Yung-Sheng Chang (2016)
[8] Wireless Cloud Interaction System Implement Motor Control", IMPACT 16", Taipei, pp.325-328. Daniel Sarb, Razvan Bogdan (2016) Wireless Motor Control in Automotive Industry", Telfor, Belgrade, pp.1-4.
[9] Frieder Endrejat, Bruce van Blerk, Giovanni Vignolo (2008) „Experience With New Large Adjustable Speed DriveTechnology Multiple Synchronous Motors", PCIC Europe, pp.1-10.
[10] Fuvesi, V. and Kovacs, E. (2011) „Modeling Loaded Starter Motor with Neural Network", CINTI, Budapest, pp.551-554.