

Actuating AC and DC Load using MATLAB Simulink

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Abstract— In today's era, industries are fully equipped by PLC and HMI (Human Machine Interface), as each day every device are being operated automatically. In proposed methodology in the paper, ATMEL Controller interfacing with the MATLAB for load management and automation is observed. Also the simulation and real time experimental results are obtained.

Key words: MATLAB, ATMEL Controller, HMI, Relays, DC and AC Machines, IR sensors

I. INTRODUCTION

Now days almost in most of the industries there are so lots of processes heavily depends on the automation and logical interfacing. This industries are using a programmable logic controller (PLC) but this industries operation can be made more optimal and economical compare to the existing operating system with the better operating conditions. This research paper indicates actuating of the AC and DC loads by using MATLAB Simulink. To make the operating system more optimised ATMEL Controller is used as communication medium between load and MATLAB Simulink.

The Atmel controller is digital operating electronic apparatus, uses a programmable memory for internal storage of instruction for implementing specific function such logic, sequencing, timing, counting and arithmetic to control through analog or digital input/ output modules various type of machines or process. The core modules of an industrial-control system are examined by analog input function, analog output functions, the distributed control (field bus) interface, digital inputs and outputs (I/O) and controlling of the loads without programming input to it for its operation.

This proposed work shows the design of a controller based system which would have 14 channel I/O and 6 channel analog Input. The system would have an ATMEL micro-controller and would also have relay cards to interface motors like DC, stepper, servo and AC motors too. Here Software MATLAB (Simulink) is used to establish a serial communication with the controller or the ATMEL circuit which is much easier than writing a machine language program. The proposed programming is user friendly that one can program this controller in the ATMEL circuit by just placing the desired blocks into it.

II. BLOCK DIAGRAM

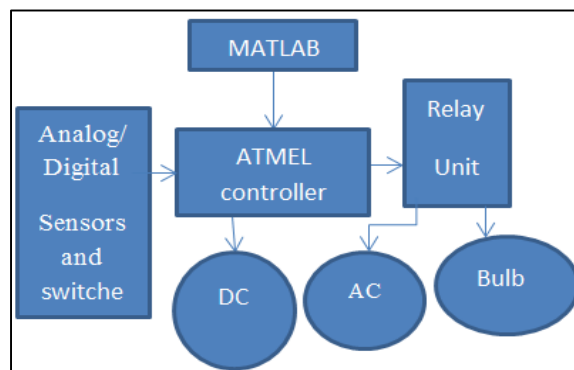


Fig. 1: Block Diagram

III. DESCRIPTION

The system is having an ATMEGA328P controller having the 14 digital I/O and 6 channel analog I/O and operated at 5V DC voltage which is having parallel connections with the 2 ICs respectively are ULN2003A and L293D.

The ULN2003A is operated at DC 12V and used for driving the AC load and controlling of it. The L293D is also having the same operation voltage and its specifications allow it to drive the operation and controlling of the DC load. The DC motor of 1000rpm is used as the DC load and the induction motor of about 30rpm and a normal bulb is included for the place of the AC load. And it is the brief about the components involved in the system.

The process starts with making connections of the ATMEL controller with the laptop having a MATLAB software through the USB interfacing. Set of 2 relay cards are connected to the ICs. The common line of the relay is connected with the load. And the numbers of the load can be connected with the system increasing the numbers of the input to the controller it can be also one of the advantage of this system. And when the supply is given to the power circuit using adaptor having 230V AC

to the 12V DC and the digital inputs are then obtained in the MATLAB software using the ATMEL controller read blocks from the ATMEL controller I/O library and then the controlling part is introduced. The inputs given to the ATMEL controller write block in the MATLAB software are then exerted to the controller through the USB interface and then the command or related logic is developed by the controller and which is next processed to the ICs and the controlling of the load is done as according to the inputs given from the MATLAB in the real time. And the controlling is done with the help of the relays to on and off the load for the specified interval of the time given by the user.

The totally controlling or handling of the load can be then done by the MATLAB software directly. And with the use of the IR sensors the controlling is done be more adaptively and as specified by the user. The push buttons can also be used for the input to the controller as to making the system more functioning and beneficial to the user.

IV. FEATURES

The system is very fast for the small industries purpose and home automation system. In this system, there is no moving parts so that low power consumption and economical. As this system is consist of 20 I/O are available and 14 digital I/O and 6 analog inputs, it is capable of handling very complicated logic operation and also easy to couple with process computer. MATLAB Simulink gives good facility to control the logic and get real time output and also change of the function is fast and sometimes online changing of the operation is available. In this system, real output of the system is available so that results are available in analog form and can be used for the further stage of processing. For the change of the logic, there is no need of the good technical knowledge. Only basic knowledge is enough for operation which makes the system simple.

This system id having some advantages which is makes it suitable for the small scale industries and home automation and security system, like having a greater number of outputs and no limits for expansion of system.

V. DESIGN OF THE SYSTEM

A. ATMEL Controller (Arduino)

As Arduino having some advantages like inexpensive, simple and clear programming also its software is an open source and expandable so it is most efficient way to use controller. The Arduino has numbers of inputs which can be used to read signal from the other circuit and output port which can be used to drive Loads like light speakers, motor, etc..

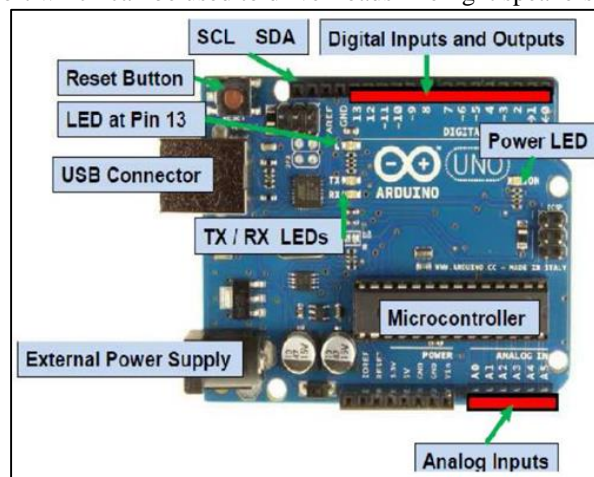


Fig. 2: ATMEL Circuit Board

B. DC Motor

DC motor is used to convert DC electrical power to the mechanical power.it can be controlled by the voltage variation.1000RPM 12V DC motors with Gearbox , 6mm shaft diameter with internal hole , 125gm weight , Stall Torque = 0.5kgcm torque , No-load current = 60 mA(Max), Load current = 300 mA is used in this model

C. Relay

Relays are the switches used for automatic on off. It protect of dispatch on circuit from the other circuit. Relay change its state by the electromagnetic effect. Energised coil is attract contacts agents the spring force.

D. IR sensor

IR sensor is working on the infrared radiation. It detects the infrared rays and use it for the further application. On later stage it is used for distance measurement, temperature sensing etc.

E. L293D IC

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit. It works on the concept of H-bridge. H-bridge is a circuit

which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence, H-Bridge IC are ideal for driving a DC motor.

F. ULN2003A

ULN2003A is a combination of seven Darlington transistor of 50v output. It is used for the switching inductive load. It is known for its high voltage high current capacity.

VI. SIMULATION DIAGRAM

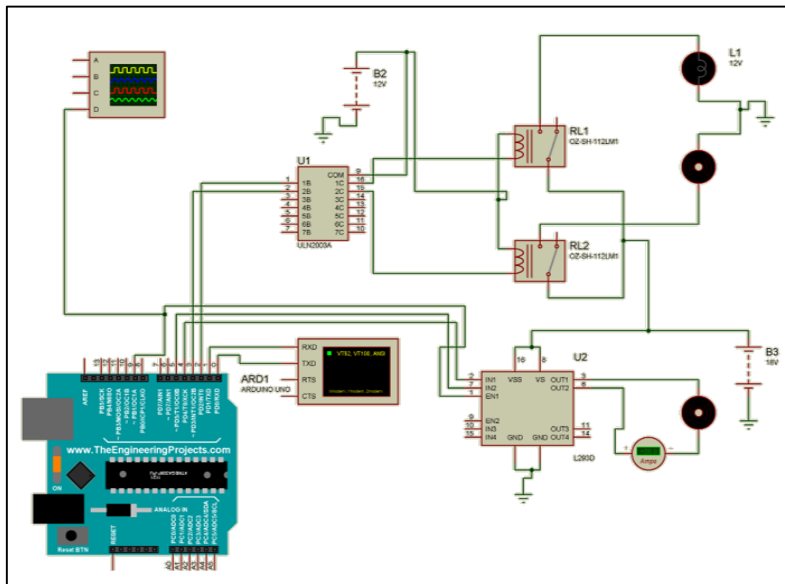


Fig. 3: Proteus circuit diagram

In this figure Arduino is programmed for controlling loads. As simulation started, virtual terminal shows command display, and load is starts working as per the program. PWM signals given to the dc motor to run on various speed

VII. SIMULATION MODEL, EXPERIMENT MODEL AND RESULTS

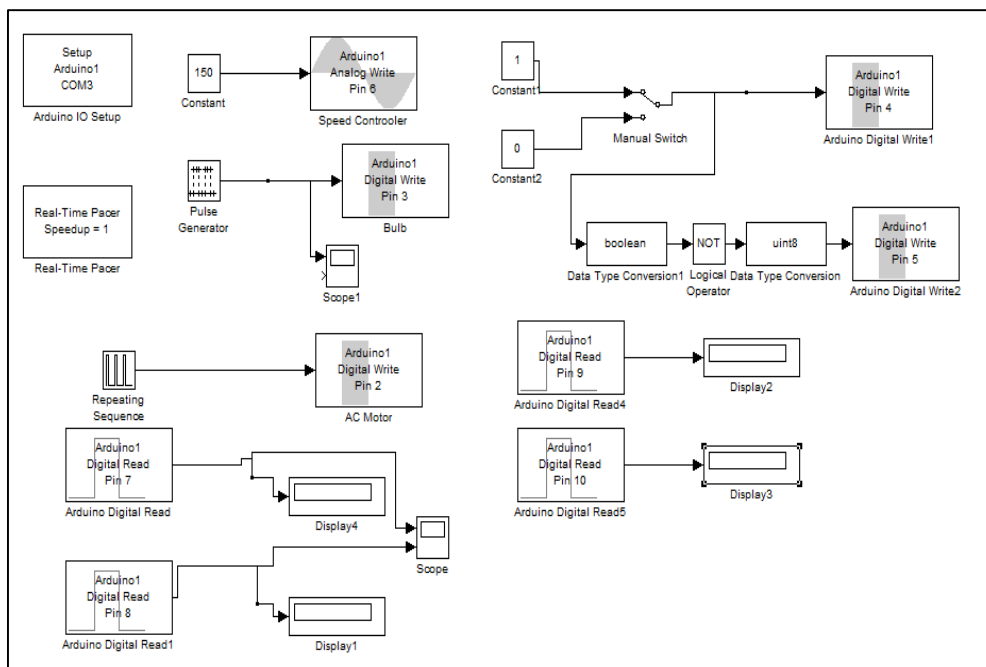


Fig. 4: MATLAB Simulink for interfacing with Arduino

Arduino library is installed in matlab for the interfacing purpose. Digital read and digital write blocks are used for read and write purpose of the program respectively. Displays shows real time input sensor condition weather it is in on state or in off state. Pulse signals is given for the controlling of speed and time of the rotations. By using manual switching circuit, DC motor can be rotate in both the direction in running operation. Also speed control is achive for DC motor. For the interfacing of arduino, cable is connected to the arduino and computer and computer detect the arduino, which COM port is having arduino is important to input data in the arduino block for interfaiing

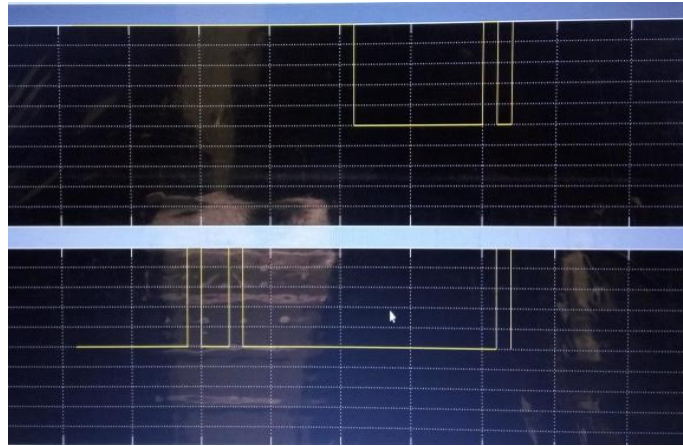


Fig. 5: Real time status of the input sensors

Figure shows real time status of the input sensor as IR sensor and push button is used for input purpose.

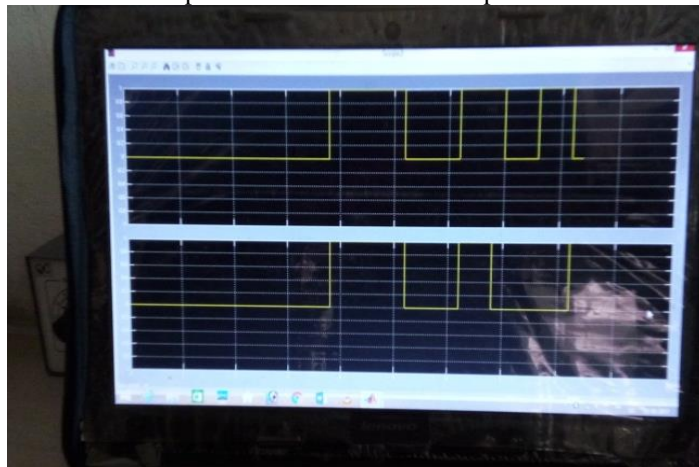


Fig. 6: Push Button current status

Push button is also use as an alternative on off controlling purpose, whether some problem occurs in the sensor then this switches can be used to control. Logical high shows on condition and logical low shows off condition.

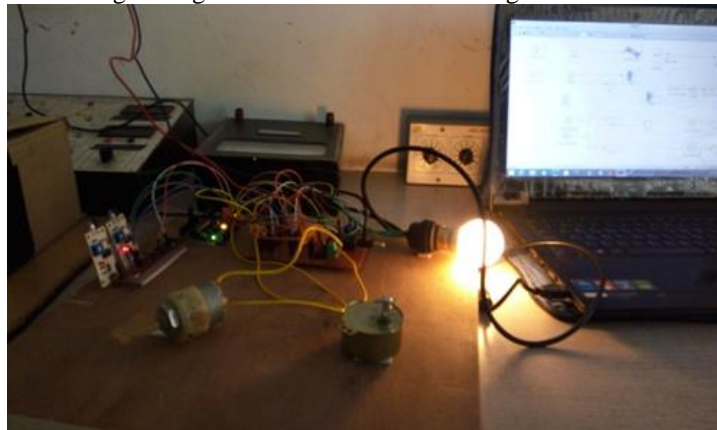


Fig. 7: Real time working model

VIII. CONCLUSION

In the paper results obtained for the proposed automated system using Atmel controller and MATLAB software is shown. It is clearly evident that this type of system has many advantages like speed of operation, direction control, expanded inputs etc. over PLC and Relay based system. The supportive illustrations and graphs/ diagrams are incorporated in the paper.

IX. FUTURE SCOPE

- Wireless System can be interfaced
- PID and Fuzzy PID blocks can be arranged
- Image Processing and Signal Processing

APPENDIX

A. Atmel Controller (Arduino)

Microcontroller	ATmega328p
Operating voltage	5v
Input voltage (recommended)	7-12v
Input voltage (limit)	6-20v
Digital I/O pins	14 (of which 6 provide PWM output)
PWM digital I/O pins	6
Analog input pins	6
DC current per I/O pin	20mA
DC Current for 3.3V pin	50mA
Flash memory	32 Kb(ATmega328p) of which 0.5 Kb used by boot loader
SRAM	2 Kb (ATmega328p)
EEPROM	1 Kb (ATmega328P)
Clock speed	16MHz

Table 1: Atmel controller (Arduino)

B. Relay

Rated voltage	12 VDC
Rated current	33.3 mA
Coil resistance	360 Ω
Must operate voltage	70% max. of the rated voltage
Max. voltage	180% of rated voltage (at 23°C)
Power consumption	Approx. 400 mW

Table 2: RELAY

C. IR sensor

Power supply: 3-5V DC 3mA

Output: 0V (low) on detection of 38 KHz carrier, 5V (high) otherwise Sensitivity range: 800nm to 1100nm with peak response at 940nm. Frequency range is 35 KHz to 41 KHz with peak detection at 38 KHz.

D. DC Motor

1000RPM 12V DC motors with Gearbox , 6mm shaft diameter with internal hole , 125gm weight , Stall Torque = 0.5kgcm torque , No-load current = 60 mA(Max), Load current = 300 mA.

E. AC Motor

- Shaft Diameter: 7mm
- Shaft Length: 16mm
- Working Voltage: AC 110-127V
- Speed: 30/36r/min
- CW/CCW (UNCONTROLLABLE)

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