Monitoring AC Drive by using RS485 & GSM Module

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Abstract: - Our research paper is aimed for developing an industrial oriented Embedded Serial Data for protocol conversion. At present, many industrial establishments face the problem of protocol compatibility with the external monitoring devices. This problem has been solved by this paper. We have successfully deployed it for monitoring parameters of AC drive by GSM module.

Here, PIC18F4550 Microcontroller works as Master and AC Drive works as slave. RTU Master Command message transmits from the PIC microcontroller and from AC Drive RTU Slave response message will come as current Frequency. The data which receives from Drive will display on LCD display and the same data will send to user by GSM Module.

Keywords: AC Drive; VFD; PIC18F4550; PIC Microcontroller; Modbus RTU; GSM; LCD;

I. INTRODUCTION

An embedded system is typically a design that uses the power of a small microcontroller, like the Microchip PIC\(^\text{®}\) microcontroller (MCU) or dsPIC digital signal controller (DSC). These microcontrollers combine a microprocessor unit (like the CPU in a personal computer) with some additional circuits called peripherals, plus some additional circuits on the same chip to make a small control module requiring few other external devices. This single device can then be embedded into other electronic and mechanical devices for low-cost digital control [1].

In this Project PIC Microcontroller is used to interface with TTL to RS485 module for communication with AC Drive. The Modbus RTU is an open, serial (RS-485) protocol derived from the Master/Slave architecture. It is a widely accepted protocol due to its ease of use and reliability.

Figure 1.1 shows the complete picture of Master and Slave while using Modbus communication. In this project, PIC18F4550 Microcontroller works as Master and AC Drive works as slave. RTU Master Command message transmits from the PIC microcontroller and from AC Drive RTU Slave response message will come as current Frequency. The data which receives from Drive will display on LCD display and the same data will send to registered user by GSM Modem. Complete Block diagram of the System is shown in the below figure 1.2.

II. AC DRIVE CONTROLLING USING MODBUS AND GSM MODEM

Power Supply:

In this Project, 5 Volts 1 amp, power supply is needed for embedded development board.

PIC Microcontroller:

An embedded system is typically a design that uses the power of a small microcontroller, like the Microchip PIC\(^\text{®}\) microcontroller (MCU) or dsPIC digital signal controller (DSC).
Figure 2.1: PIC18F4550 Controller IC

PIC families have included 18F4550 Controller [2] which is used in our project for interfacing with other devices. In 1989, Microchip technology Corporation introduced an 8-bit microcontroller called PIC, which stands for peripheral Interface Controller. This microcontroller had small amounts of data RAM, a few hundred bytes of on-chip ROM for the program, one timer, and a few pins for I/O ports, all on a single chip with 8 pins. The PIC18 has a RISC architecture that comes with some standard features such as on-chip program (Code) ROM, data RAM, and data EEPROM, Timers, ADC, USART and I/O ports.

The main features of PIC18F4550 Controller are below.

- 1K byte Dual Port RAM + 1K byte GP RAM
- Full Speed Transceiver
- Streaming Port
- Internal Pull Up resistors (D+/D-)
- 48 MHz performance (12 MIPS)
- Pin-to-pin compatible with PIC16C7X5

AC Drive (VFD):

An ac drive is a device that is used to control the speed of an electrical motor. The speed is controlled by changing the frequency of the electrical supply to the motor. An ac drive converts the frequency of the network to anything between 0 to 300Hz or even higher, and thus controls the speed of motor proportionally to the frequency.

In this Paper, we have used AC Drive (Variable Frequency Drive) for the Modbus RTU Communication. Here, VFD works as Slave and send the data as response of transmitted data.

TTL to RS485 Module:

On-board MAX485 chip is a low-power and slew-rate-limited transceiver used for Modbus (RS-485) communication. It works at a single +5V power supply and the rated current is 300 µA. Adopting half-duplex communications to implement the function of converting TTL level into RS-485 level, it can achieve a maximum transmission rate of 2.5Mbps. MAX485 transceiver draws supply current of between 120µA and 500µA under the unloaded or fully loaded conditions when the driver is disabled. The driver outputs can be placed at a high impedance state through the thermal shutdown circuit. The receiver input has a fail-safe feature that guarantees logic high output if the input is open circuit.

The Connection of TTL to RS485 Module is given in below table 2.1.

![Figure 2.3: Actual View of TTL to RS485 Module](image)

Table 2.1: Connections of TTL to RS485 Module

<table>
<thead>
<tr>
<th>Pins of TTL to RS485</th>
<th>Development Board/AC Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>VCC</td>
</tr>
<tr>
<td>A</td>
<td>+485 of AC Drive</td>
</tr>
<tr>
<td>B</td>
<td>- 485 of AC Drive</td>
</tr>
<tr>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>DI</td>
<td>Tx of Development Board</td>
</tr>
<tr>
<td>DE</td>
<td>Short and Give to Any Port of Microcontroller</td>
</tr>
<tr>
<td>RE</td>
<td></td>
</tr>
<tr>
<td>R0</td>
<td>Rx of Development Board</td>
</tr>
</tbody>
</table>

GSM Module:

A GSM (Global System for Mobile Communications) modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone which is helpful to send data of Frequency and Voltage to user in the format of Text Message [5].

![Figure 2.2: AC Drive/VFD](image)
The Connection of GSM module is given in below table 2.2.

<table>
<thead>
<tr>
<th>Parameter of PIR Sensor</th>
<th>Development Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>VCC</td>
</tr>
<tr>
<td>RX</td>
<td>TX (RC6)</td>
</tr>
<tr>
<td>TX</td>
<td>RX (RC7)</td>
</tr>
<tr>
<td>GND</td>
<td>GND</td>
</tr>
</tbody>
</table>

Table 2.2: Connections of GSM Module

LCD Display

The LCD Display is used to display the data on the screen. The Connection of LCD display is given in below figure 2.5.

III. WORKING OF THE SYSTEM

In this Project PIC Microcontroller is used to interface with TTL to RS485 module, LCD display, and AC Drive.

Once the 5V supply is given to the system, the Development board will be initialized. Once the board is ON, Microcontroller transmits the data to the AC Drive where Microcontroller works as Master and AC Drive works as the Slave. The RTU Master Command message (from the master to the VFD) receive by the AC Drive and RTU slave response message comes from VFD to Controller which will be display on the LCD Display. If any of the condition is not true then, go back to the previous condition and check to get the correct data at the end.

Once the data received by controller, the same data of Frequency and voltage send to the user by using GSM Module. The complete flow diagram of the system is shown in below figure 3.
IV. CONCLUSION

In this paper, we developed an industrial oriented embedded serial data interpreter for protocol conversion. This system has been designed and simulated in order to obtain the predicted results. From this method, industrial establishments get the advantage of Modbus RTU communication protocol compatibility with the external monitoring devices (GSM Module).

REFERENCES