Abstract - The Aim is to design and develop a control system based an electronically controlled Web based E-server speed control system for PMSM which is based on fuzzy logic instead of obsolete indirect vector control using PI controller as a speed regulator in outer speed loop. In obsolete method for speed control system of a PMSM drive uses a voltage source pulse width modulation inverter-fed vector controlled indirectly which is having low precision for the speed control giving bad speed regulation characteristics and decreasing the performance of the whole PMSM motor drive. To prevail over this PI controller by a automatically sensing fuzzy control system which is based on fuzzy set theory. The execution of this automatically sensing fuzzy control system can be inquired through digital simulation which is based on MATLAB-SIMULINK package as well as Hardware. By using this digital simulation system the performance of fuzzy control system can be seen by creating variable operating conditions by varying reference speeds and at different load torques. Consequences of this digital simulation system shows improved performance characteristics of the suggested fuzzy control system over the obsolete PI controller as a speed regulator in outer speed loop. Hardware part can explain real time web server tool can control speed of PMSM motor.

Keywords- WSN- WiFi Module, PMSM Motor, ARM cortex Micro controller, UART Serial Communication, Simulation MATLAB 2014, Embedded Program – Embedded C, CCS Compiler, Web Server - HTML

I. INTRODUCTION

Difficult in dealing with continuous parametric variation in all kinds of motor but also the non-linearity present in the entire system, it better to go for intelligent controller.

As it is known that the stator and rotor resistances of motor may change with the temperature up to 50% and by changing the magnetic operating point which varies the motor inductance and also the load torque may change due to mechanical disturbances of PMSM:

The trapezoidal PMAC machines also called Brushless DC motors (BLDC)
This problem can be solved by using several adaptive control techniques like model reference adaptive control, sliding-mode control, variable structure control, and self tuning PI controllers, etc.

The Permanent Magnet Synchronous Motor (PMSM) has become a pronounced choice for low and mid power applications such as computer peripheral equipments, robotics, adjustable speed drives and electric vehicles.

**OVER View of the Projects**

\[
\begin{array}{ccc}
\text{Data management} & \Rightarrow & \text{Fuzzy control} \\
& & \downarrow \text{Indirect vector control +} \\
\text{Web server tool box} & & \text{PMSM model}
\end{array}
\]

It has some special features like high power density, high torque/inertia ratio, high operating efficiency, variable speed operation, reliability, and low cost etc. Torque Generation: A reactance torque of PMSM is generated by an interaction of two magnetic fields (one on the stator and one on the rotor). The stator magnetic field is represented by the magnetic flux/stator current. The magnetic field of the rotor is represented by the magnetic flux of permanent magnets that is constant, except for the field weakening operation. We can imagine those two magnetic fields as two bar magnets, as we know a force, which tries to attract/repel those magnets, is maximal, when they are perpendicular to each other. It means that we want to control stator current in such a way that creates a stator vector perpendicular to rotor magnets. As the rotor spins we must update the stator currents to keep the stator flux vector at 90 degrees to rotor magnets at all times. The reactance torque of an interior PM type PMSM (IPMSM) is as follows, when stator and rotor magnetic fields are perpendicular.

\[
\text{Torque} = 32pp \Phi_{PM} I_{qs}
\]

*pp* - Number of pole pairs

\( \Phi_{PM} \) - Magnetic flux of the permanent magnets

\( I_{qs} \) - Amplitude of the current inquadrature axis

As shown in the previous equation, reactance torque is proportional to the amplitude of the q-axis current, when magnetic fields are perpendicular.

MCUs must regulate the phase stator current magnitude and at the same time in phase/angle, which is not such an easy task as DC motor control.

## II. EXISTING METHOD

In Existing system, a general web-based e-service system for the PMSM is proposed first. We then design high-performance PMSM-PEDs, which can reduce the effect of the load noise and have good speed transient response under the condition of uncertain mechanic inertia and friction for a web-based e-service system. These systems are widely and commonly used in robots and manipulator, etc. Furthermore, we also present the control structure, which is applied for PMSM-PEDs as follows.

We suggest an improved direct adaptive fuzzy (IDAF) algorithm, which is based on direct adaptive fuzzy.

The control structure with self-regulating fuzzy parameters is considered the self-learning system. As we can see in and , it is clear that in the math field, DAF is completely similar direct adaptive fuzzy neural network.

The operation beyond the machine base speed requires the PWM inverter to provide output voltages higher than its output capability limited by its DC link voltage. To overcome the base speed limitation, a field-weakening algorithm can be implemented. A negative d-axis required current will increase the speed range, but the applicable torque is reduced because of a stator current limit. Manipulating the d-axis current into the machine has the desired effect of weakening the rotor field, which decreases the BEMF voltage, allowing the higher stator current to flow into the motor with the same voltage limit given by the DC link voltage.
III. PROPOSED METHOD

The vector control of Induction Motor with fuzzy PI controller which was proposed to control the speed of pmsm motor. The performance of automatically sensing controller based on fuzzy logic for the speed control of indirect vector controlled, PWM voltage source inverter fed PMSM motor drive authenticated and compared with that of obsolete PI controller performance.

Transmitter

Receiver

Permanent magnet synchronous motors (PMSM) are typically used for high-performance and high-efficiency motor drives. High-performance motor control is characterized by smooth rotation over the entire speed range of the motor, full torque control at zero speed, and fast acceleration and deceleration. To achieve such control, vector control techniques are used for PM synchronous motors. The vector control techniques are usually also referred to as field-oriented control (FOC).

UARTs - The LPC2141/42/44/46/48 each contain two UARTs. In addition to standard transmit and receive data lines, the LPC2144/46/48 UART1 also provides a full modem control handshake interface. Compared to previous LPC2000 microcontrollers, UARTs in LPC2141/42/44/46/48 introduce a fractional baud rate generator for both UARTs, enabling these microcontrollers to achieve standard baud rates such as 115200 with any crystal frequency above 2 MHz. In addition, auto-CTS/RTS flow-control functions are fully implemented in hardware (UART1 in LPC2144/46/48 only).
The maximum allowable peripheral speed of the rotor is a central consideration in machine design. With present-day steel alloys, rotor peripheral speeds of 50,000 ft/min (or about 250 m/s) represent the design limit.

1 ft/min = 0.0051 m/s

The basic idea of the vector control algorithm is to decompose a stator current into a magnetic field-generating part and a torque-generating part. Both components can be controlled separately after decomposition. Then, the structure of the motor controller (vector control controller) is almost the same as a separately excited DC motor, which simplifies the control of a permanent magnet synchronous motor.

Typically

\[ V_0 \leq 8 \text{ in}^3/(\text{ft} \times \text{lb}) \text{ for 10hp or less (air cooled)} \]

\[ V_0 \leq 4 \text{ in}^3/(\text{ft} \times \text{lb}) \text{ for 10hp or more (water cooled)} \]

The unit for \( D \) and \( L \) is inch.

If we design \( D=L \), we have the stator bore (inner) diameter estimated

\[ D_{\text{estimated}} = \left( \frac{V_0}{0.009} \right)^{1/3} \]

We can pick up \( D \) close to \( D_{\text{estimated}} \).

**Pulse width modulator**—The PWM is based on the standard timer block and inherits all of its features, although only the PWM function is pinned out on the LPC2141/42/44/46/48. The timer is designed to count cycles of the peripheral clock (PCLK) and optionally generate interrupts or perform other actions when specified timer values occur, based on seven match registers. The PWM function is also based on match register events.

The ability to separately control rising and falling edge locations allows the PWM to be used for more applications. For instance, multi-phase motor control typically requires three non-overlapping PWM outputs with individual control of all three pulse widths and positions.

Two match registers can be used to provide a single edge controlled PWM output. One match register (MR0) controls the PWM cycle rate, by resetting the count upon match. The other match register controls the PWM edge position. Additional single edge controlled PWM outputs require only one match register each, since the repetition rate is the same for all PWM outputs. Multiple single edge controlled PWM outputs will all have a rising edge at the beginning of each PWM cycle, when an MR0 match occurs.

Three match registers can be used to provide a PWM output with both edges controlled. Again, the MR0 match register controls the PWM cycle rate. The other match registers control the two PWM edge positions. Additional double edge controlled PWM outputs require only two match registers each, since the repetition rate is the same for all PWM outputs.

With double edge controlled PWM outputs, specific match registers control the rising and falling edge of the output. This allows both positive going PWM pulses (when the rising edge occurs prior to the falling edge), and negative going PWM pulses (when the falling edge occurs prior to the rising edge).

**Motor Losses**

1. Copper loss
   - i. Typical
     \[ P_{\text{Cu}} = I^2 R \]
   - ii. Stray losses
     Electrical phenomenon such as skin and proximity effect

2. Core (Iron) Loss
   - i. Hysteresis loss
     \[ P_{\text{Iron}} = k_b B^a f (\kappa_c B)^{1/2} \]
   - ii. Eddy Current loss

3. Mechanical loss
   - i. Windage loss
ii. Friction loss

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30% with minimal performance penalty.

Power control - The LPC2141/42/44/46/48 supports two reduced power modes: Idle mode and Power-down mode.

In Idle mode, execution of instructions is suspended until either a reset or interrupt occurs. Peripheral functions continue operation during Idle mode and may generate interrupts to cause the processor to resume execution. Idle mode eliminates power used by the processor itself, memory systems and related controllers, and internal buses.

In Power-down mode, the oscillator is shut down and the chip receives no internal clocks. The processor state and registers, peripheral registers, and internal SRAM values are preserved throughout Power-down mode and the logic levels of chip output pins remain static. The Power-down mode can be terminated and normal operation resumed by either a reset or certain specific interrupts that are able to function without clocks. Since all dynamic operation of the chip is suspended, Power-down mode reduces chip power consumption to nearly zero.

Selecting an external 32 kHz clock instead of the PCLK as a clock-source for the on-chip RTC will enable the microcontroller to have the RTC active during Power-down mode. Power-down current is increased with RTC active. However, it is significantly lower than in Idle mode.

A Power Control for Peripherals feature allows individual peripherals to be turned off if they are not needed in the application, resulting in additional power savings during active and Idle mode.

Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I²C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

IV. SIMULATION

Sim. FIG 1

Sim. OUTPUT 1

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V. ADVANTAGES

1. It is similar to the human thinking process by using the linguistic, not numerical, variables.
2. It more accurate and stable than the obsolete controller by relating output to input, without understanding all the variables.
3. Simplicity allows the solution of previously unsolved problems.
4. As it does not have to know everything before starting work the Rapid prototyping is possible.
5. Robustness has increased. It encompasses great complexity by some rules.

VI. CONCLUSION

In this project we proposed a method to identify the speed control of PMDC motor which is been controlled based on fuzzy logic with the help of sensors and the data’s are transmitted and received with the help of wireless sensors. This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries. We are proud that we have completed the work with the limited time successfully. The FUZZY ADAPTIVE INTERNAL MODEL CONTROL SCHEMES FOR PMSM SPEED-REGULATION SYSTEM is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus we have developed an “FUZZY ADAPTIVE INTERNAL MODEL CONTROL SCHEMES FOR PMSM SPEED-REGULATION SYSTEM” which helps to know how to achieve low cost automation. The application of sensor produces smooth operation. By using more techniques, they can be modified and developed according to the applications.

VII. REFERENCE