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Speed Control of a Linear Induction Motor Using V/F Technique

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Abstract— Speed control of single phase Linear Induction Motor using V/F method have been widely used in fans and pumps drives. High-power Linear Induction Motors (LIMs) face challenges in managing speed. Traditional system are ineffective, causing inefficiency and potential damage. To address this, our project proposes a control system for LIM speed control suing V/f method. Currently, linear induction motors (LIMs) are widely used in many industrial applications, including transportation, conveyor systems, actuators, material handling, pumping of liquid metal, sliding-door closers and others, with satisfactory performance. The proposed control system consists of Arduino controller , soft switching for controlling and motor driver board to run Linear induction motor with voltage and frequency monitoring. This control system has almost no effect in normal operation of LIM. Hardware testing results are obtained to verify the valuable operation of proposed circuit in Speed control of LIM.

Keywords—Linear Inuction Motor , Speed Control, V/f Method , Arduino Controller , LCD Display etc.

I. Introduction

Linear Induction motors speed and direction are used in large number of applications such as blowers, fans, mixers, crushers, grinders, pumps and many other modern industrial applications. Voltage controller is the basic part of speed and direction of Linear induction motor which is controlled to adjust the inrush current and developed torque. This project presents a speed and direction of Linear induction motor which is based upon starter of Linear Induction Motor by AC pulse width modulation method the presented implementation gives satisfactory.

This project presents a speed and direction of Linear induction motor which is based upon starter of Linear Induction Motor by AC pulse width modulation method the presented implementation gives satisfactory. These current and speed surges can be reduced substantially by reducing the voltage supplied to the motor during starting. AC voltage controller-based speed Linear induction motor offer many advantages over conventional starters such as the following.

Smooth acceleration, which reduces stress on the mechanical drive system due to high starting torque hence increases the life and reliability of belts, gear boxes, chain drives, motor bearings, and shafts. Smooth acceleration reduces also stress on the electrical supply due to high starting currents meeting utility requirements for reduced voltage starting and eliminating voltage dip and brown out conditions.

By using speed and direction of LIM the controlled voltage is applied at the motor input so the motor is protected and life of motor increases. V/f control is a method to control a ratio between primary voltage (V) to be applied to the LIM and inverter output frequency (f) to be constant.

II. Existing System

The single phase Linear Induction Motor during the initial starting condition draws up much higher current than its capacity and the motor instantly reaches the full speed. This results in a mechanical jerk and high electrical stress on the windings of the motor. Sometimes the windings may get burnt. The Linear Induction Motor should start smoothly and gradually catch up the speed for a safer operation. This project is designed to give a speed control to the Linear Induction Motor based on the SCR firing triggered by heavily delayed firing angle during starting and then gradually reducing the delay till it reaches zero voltage triggering. This results in low voltage during start and then gradually to full voltage. Thus the motor starts slowly and then slowly picks up to full speed.

III. Proposed System

This project present the speed control of single phase Linear Induction motor using Arduino with the controlling objectives of voltage and frequency applied. LIM are widely used Electrical Motors due to their reliability, low cost and robustness. However, Linear Induction Motors do not inherently have the capability of variable speed of operation. Due to this reason, earlier dc Motors were applied in most of the Electrical Drives. But the recent developments in speed control methods of the Linear Induction Motor have led to their large scale use in

all Electrical Drives. Out of the several methods of speed control of an induction such as pole changing, frequency variation, variable rotor resistance, variable stator voltage, constant V/f control, slip recovery method etc., the closed loop constant V/f speed control method is most widely used.

IV. Objective

- To detect the speed control of single phase Linear Induction motor using voltage and frequency method.
- Speed control of linear induction motor carried by controlling voltage and frequency
- The implementation and analysis of Linear Induction motor is completely carried out using Arduino.
- Comparison of results with previous research.

V. Literature Review

- R. Deekshath et. al. 2018 "IoT platform for condition monitoring of industrial motors" [1], Numbers of things are efficiently interconnected**,** which leads to condition and controlled monitoring to increase productivity. Continuous monitoring of the equipment, receiving alerts and data availability for predictive maintenance. Motor is effectively and continuously monitored by using web location.
- Sharmad Pasha, et al. 2016 "IoT-based traction motor drive condition monitoring in electric vehicles: Part 1." Power Electronics and Drive Systems (PEDS), 2017 IEEE 12th International conference[2]. In electric vehicles, The motor drive condition for traction was supervised by applying the implementation of a wireless Internet of Things(IoT). The design and testing of the prototype using an ESP8266 microcontroller module to acquire motor condition is presented.
- S. S. Darbastwar et al. 2016. "Smart Shut-Down and Recovery Mechanism for Industrial Machines Using Internet of Things." 2018 8th International Conference on Cloud Computing, Data Science & Engineering (Confluence). IEEE[3], For predictive maintenance of motors in the industries, monitoring needs to be performed continuously so as to determine any degradation in performance or failure of the motors. The recovery mechanism provides a back-up machine which is started when the main motor is shut down. This helps in decreasing the loss that would occur during the downtime. This increases the reliability.
- B. Lu, T. G. Habetler et al. 2008. "IoT-based wireless induction motor monitoring. " Scientific Conference Electronics (ET), 2008 XXVI International. IEEE, 2008.[4], In this way, the production process is not impeded and the required maintenance or replacement can be performed with the least possible disruption. This study has provided statistics not only for creating mathematical models but also for enabling the CMS operator to establish a motor maintenance schedule.
- J. Pedro Amaro 2010. "The application of wireless sensor networks for condition monitoring in three-phase induction motors." Electrical Insulation Conference and Electrical Manufacturing Expo, *2007*. IEEE, 2007.[5], The most commonly used technique for the detection of faults in large three-phase induction motors is to measure the supply current fed into the motor and analyse the signal spectrum. This aspect allows companies to reduce downtime when repairing machinery and ensures that productivity does not suffer.

VI. Block Diagram

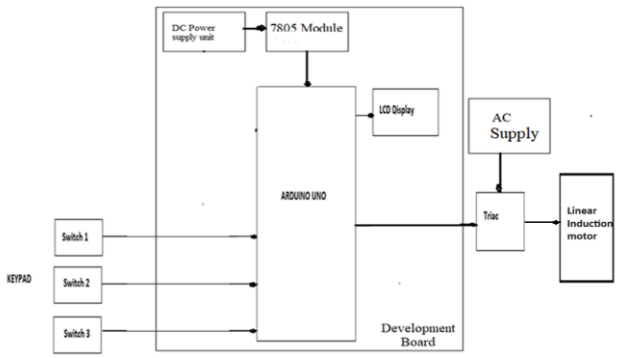

Fig.1.Block Diagram of system

VII. Working

This project attempts a new speed control technique for single phase Linear induction motor. It has low cost, high efficiency drive capable of supplying a single phase LIM with PWM modulated sinusoidal voltage and frequency. The circuit operation control by an Arduino controller.

The device is aimed at substituting commonly used TRIAC phase angle control drives. The circuit is capable of supplying single phase Linear induction motor (inductive or resistive load) with varying AC voltage.

3 switches are introduce in this project , 1 switch (I) is used to increased the speed , 2 switch is used to decreased the speed (D) and 3 switch (S) is sued to Stop Function. This variation in speed leads due to voltage and frequency variation V/f method. All this voltage and frequency information is written on LCD display through Arduino Uno control board.

VIII. Components Used

- Linear Induction Motor
- Arduino UNO
- Traic Board
- Speed controlling Switches
- Development Board
- Power Supply Unit
- LCD Display
- Others.

- In this project, a novel method for controlling soft-starter linear induction-motor-drive systems is introduced.
- At start , all components attached to system is initialize.
- AC supply is given to Linear induction motor.
- Keypad signals decode by controller. Decision is made by controller.
- For No , Linear Induction Motor is stop through Triac. OFF status Message will display on LCD.
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- For yes , Linear Induction Motor is running at different speed through Triac. ON status, voltage and frequency will display on LCD.

IX. Circuit Diagram

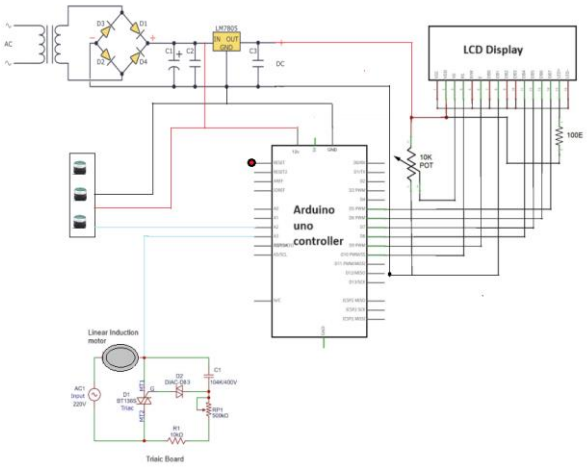

Fig.2.Circuit Diagram

X. Results And Discussion

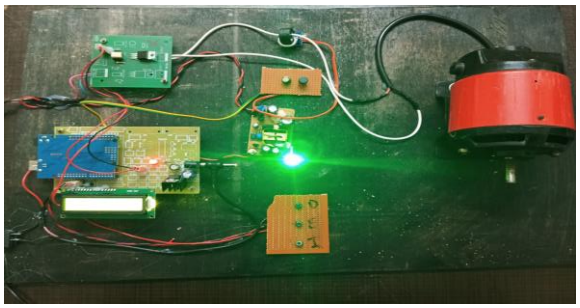

Fig.3.Project Model

- In this project using V/F technique for early detection and monitoring of LIM system failures. The system has the ability to combine various sensed parameters in real time and monitor using LCD display.
- The monitoring of the Linear induction motor system presents the measurement of different parameters namely voltage , current, speed level. Thus, compared to other conventional methods this system has more number of fields will display and quick controlling. The concept of LCD is presented here for monitoring and controlling the LIM using V/F method.

Initial project name on display

At Speed Level 1, Value of Frequency, Current and Voltage

At Speed Level 2, Value of Frequency ,Current and Voltage

At Speed Level 3, Value of Frequency, Current and Voltage

At Speed Level 4, Value of Frequency, Current and Voltage

At Speed Level 5, Value of Frequency, Current and Voltage

Table 1 : Output readings from Model

Voltage	Frequency	Speed	Current
156	49.2	1360	73
184	49.4	2720	92
196	49.7	4080	98
219	49.8	5440	108
220	50	6800	1010

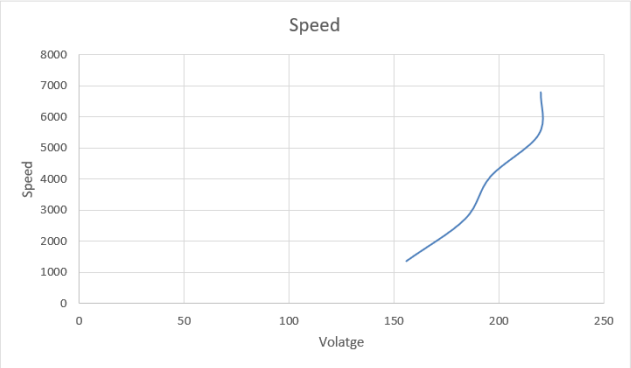

Fig.4. Graphical View of voltage and speed

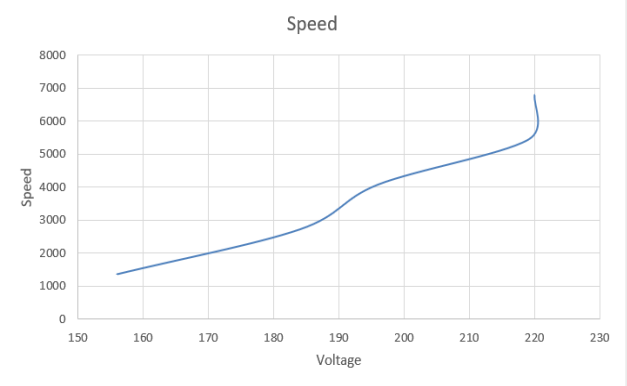

Fig.5.Graphical View of frequency and speed

- The results of the experiments will be the effectiveness and practicality of the V/F technique for speed control of Linear induction motors using Arduino. While further optimizations and improvements may be needed, the system shows promise for a wide range of applications, contributing to more efficient and reliable motor control solutions.
- Overall, the V/F technique is a widely used and effective method for speed control of Linear induction motors in many industrial applications where precise speed control is not critical. However, for applications requiring precise speed control over a wide range or at low speeds, other control techniques such as vector control may be more suitable.

XI. Conclusion

The proposed technique with results has shown that this speed controlling method by V/f method properly. Reliability of this method is very high for the starting conditions of the Linear induction motor as this method is operate within the fractions of seconds when LIM is started. This method is fully automated and will not produce any harmonics by using this method we can improve the life of the machines. The VFD method proposed in this project is first integrated innovation that absorbs advantages of speed control method. The V/f method for speed control of Linear Induction Motors offers a reliable, automated, and harmonics-free solution that enhances machine life and operational efficiency. With its rapid response time and seamless integration, it represents a significant advancement in speed control technology for Linear Induction Motor.

The combination of V/F technique and Arduino technology offers a versatile, cost-effective, and scalable solution for speed control of Linear induction motors in various industrial, commercial, and residential applications. With ongoing advancements in microcontroller technology and control algorithms, the potential for innovation and optimization in this field is vast, paving the way for smarter, more efficient motor control systems in the future.

XII. FUTURE SCOPE

Furthermore, the project opens up opportunities for future enhancements and optimizations. Additional features such as sensor feedback for closed-loop control, PID (Proportional-Integral-Derivative) tuning for improved response, and wireless connectivity for remote monitoring can be implemented to further enhance the functionality and performance of the system.

References

[1] Ming-Fa Tsai, Hsien-Chang Chen, “Design and implementation of a CPLD-based SVPWM ASIC for variable-speed control of AC motor drives” Published in: Power Electronics and Drive Systems, 2001. Proceedings., 2001 4th IEEE International Conference on (Volume:1) Page(s): 322 - 328 l.1.

[2] Kusch, R., Naunin, D., “Position-sensorless smooth torque control of a squirrel cage synchronous reluctance motor” Published in: Industrial Technology, 2003 IEEE International Conference on (Volume:1) Page(s): 560 - 565 Vol.1.

[3] Zargari, N., Seggewiss, G., Turton, R., Rizzo, S. “Multiple medium voltage AC drives fed from a common AC bus for single or multi motor conveyor applications” Published in: Power Electronics and Applications, 2005 European Conference on Page(s): 9 pp. - P.9.

[4] Briz, F., Degner, M.W., Diez, A., Lorenz, R.D. “Measuring, modeling and decoupling of saturation-induced saliencies in carrier signal injectionbased sensorless AC drives” Published in: Industry Applications Conference, 2000. Conference Record of the 2000 IEEE (Volume :3) Page(s): 1842 - 1849 vol.3.

[5] Vaclavek, P., Blaha, P, “Speed Estimation Scheme for Small AC Induction Machine Sensorless Control” Published in:Industrial Electronics Society, 2007. IECON

2007. 33rd Annual Conference of the IEEE Page(s): 986 – 991.
[6] Nied, A., de Oliveira, J., de Campos, R.F., Dias, R.P., "Soft Starting of Induction Motor with Torque Control" Published in: Industry Applications Society Annual Meeting, 2008. IAS '08. IEEE Page(s): 1 – 6.
[7] Comanescu, Mihai, "An Induction-Motor Speed Estimator Based on Integral Sliding-Mode Current Control" Published in: Industrial Electronics, IEEE Transactions on (Volume:56 , Issue: 9) Page(s): 3414 – 3423 of 2009.
[8] Liang, X., O. Ilochonwu, 2011. Induction motor starting in practical industrial applications, IEEE Transaction on Industry Application, 47: 271-280.
[9] Mark, G., Solveson, Behrooz Mirafzal, and Nabeel A.O. Demerdash, 2006. Soft-Started Induction Motor Modeling and Heating Issues for Different Starting Profiles Using a Flux Linkage ABC Frame of Reference, IEEE Transaction on Industry Application, 42: 973-982.
[10] Nied, A., de J. Oliveira, de R. Farias Campos, R.P. Dias, de L.C. Souza Marques, 2010. Soft Starting of Induction Motor With Torque Control, Industry Applications, IEEE Transactions on, 46: 1002-1010.
[11] Nied, A., de Oliveira, J., de Campos, R.F., Dias, R.P., "Soft Starting of Induction Motor with Torque Control" Published in: Industry Applications Society Annual Meeting, 2008. IAS '08. IEEE Page(s): 1 – 6.
[12] Comanescu, Mihai, "An Induction-Motor Speed Estimator Based on Integral Sliding-Mode Current Control" Published in: Industrial Electronics, IEEE Transactions on (Volume:56 , Issue: 9) Page(s): 3414 – 3423 of 2009.
[13] Liang, X., O. Ilochonwu, 2011. Induction motor starting in practical industrial applications, IEEE Transaction on Industry Application, 47: 271-280.
[14] Mark, G., Solveson, Behrooz Mirafzal, and Nabeel A.O. Demerdash, 2006. Soft-Started Induction Motor Modeling and Heating Issues for Different Starting Profiles Using a Flux Linkage ABC Frame of Reference, IEEE Transaction on Industry Application, 42: 973-982.
[15] Nied, A., de J. Oliveira, de R. Farias Campos, R.P. Dias, de L.C. Souza Marques, 2010. Soft Starting of Induction Motor With Torque Control, Industry Applications, IEEE Transactions on, 46: 1002-1010.