

Speed Synchronization and control of Multiple Motor in Industry

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Abstract:

The speed synchronization among the motors is almost essential in many industries, such as textile production, woodworking for paper, and metallurgy for steel plants, allowing the operation of processes together without damaging the material. In the past, synchronization was done mechanically, but this was heavy and allowed very little freedom of operation. The current project involves a wireless scheme for speed synchronization of multiple motors through the HC-05 Bluetooth module, without using a dedicated transmitter. There is one master motor in the setup, with the rest being slaves. The speed of the master motor is monitored and wirelessly transmitted through the HC-05 module to the slaves, wherein each slave motor reads the speed data of the master and adjusts its speed accordingly in order to maintain synchronization. Microcontrollers implement speed information processing and output PWM signals to drive the motors. The control also has feedback units, such as sensors mounted on shafts, which immediately provide speed information to the control system. Hence, possible advantages from the adoption of this wireless speed-synchronization would be greater flexibility to changes in the industrial plant, reduction of wiring complexity, and it is also scalable wherein modern industries find very attractive.

Keywords: Speed synchronization of motor, Automation, Protection, Control, Microcontroller, Fault Detection, Real-Time Control.

1. INTRODUCTION

With a steady augmenting need for electric motor-driven machines, it has become crucial. Being cheap, hardly requiring any maintenance owing to their basic rotor design, and nice to have power factors, have made induction motors most preferred since they are compact, highly durable, and cost efficient. The induction motors enjoy excellent speed control, continuous overload capability, and heavy starting torque. This model gives rise to the application of the induction motors in industries, cranes, elevators, home, and farm motors.

IoT (Internet of Things), increasingly considered an enabling technology for the current wave of wireless communication enhancement, surely has benefits in the industrial sector. Remote accessibility is just one of the roles performed by IoT toward industrial automation. An ordinary setup interconnects multiple IoT devices. Throughout this platform, important data and performance optimization parameters are exchanged among diverse devices to optimize performance. The representational model uses IOT-dependent parameters viz., speed measurement using a sensor and cloud to monitor and control the Induction motor speed through TRIAC control since its speed can be easily varied by altering the supply voltage. The prime aim is to design a cheap and effective protection for induction motors. The protection scheme shall provide protection under and over voltage to prevent stoppages in production in industries.

2. LITERATURE SURVEY

- **"Centralised Speed Synchronization of DC Motor using Wireless Communication"**
Authors: Abhishek B, Yashaswini S, Lokesh Kumar, Sandhya M N *Published in:* International Journal of Engineering Research & Technology (IJERT), Volume 6, Issue 13, 2018 *Summary:* This paper discusses a system designed to control the speed and synchronization of DC motors using wireless modules, enhancing efficiency and reducing maintenance in industrial settings.
- **"Speed Synchronisation of Multiple Motors and Variable Flow Controlling of Motor"**
Authors: Gauri R. Shinde, Ashwini T. Deshmukh, Prof. R. V. Katre *Published in:* International Research Journal of Engineering and Technology (IRJET), Volume 4, Issue 2, 2017 *Summary:* The study presents a microcontroller-based design and implementation for speed control of motors, addressing the need for effective control methods in industrial applications.
- **"Speed Synchronization of Multiple BLDC Motor Drive using Arduino"**
Authors: Not specified *Published in:* IEEE Conference Publication, 2023 *Summary:* This paper explores the use of Arduino microcontrollers for the speed synchronization of multiple Brushless DC (BLDC) motors, highlighting the system's design and performance in industrial applications.
- **"Speed & Direction Control of DC Motor through Bluetooth HC-05 Using Arduino"**

Authors: Not specified *Published in:* IEEE Conference Publication, 2019 *Summary:* The study focuses on controlling the speed and direction of a DC motor via Bluetooth communication using the HC-05 module and Arduino, demonstrating a wireless approach to motor control.

- **"Speed Control of Single Phase Induction Motor by Android Bluetooth"**

Authors: Not specified *Published in:* International Research Journal of Engineering and Technology (IRJET), Volume 4, Issue 1, 2017 *Summary:* This paper presents a method for controlling the speed of a single-phase induction motor using an Android device and Bluetooth technology, showcasing the integration of mobile platforms in industrial motor control.

- **"A Review Paper on Synchronization Speed Control of Multiple Motors"**

Authors: Prof. S. D. Lavange, Vaibhav D. Kakar, Gaurav H. Bhagat, Abhishek S. Rodhe, Aarti S. Kale, Ujvala A. Thorat *Published in:* International Journal for Science and Advance Research in Technology (IJSART), Volume 11, Issue 1, 2025 *Summary:* This review paper discusses various methodologies for synchronizing and controlling the speed of multiple motors, emphasizing the role of microcontrollers and wireless communication in modern industrial automation.

- **"Speed Synchronization and Control of Multiple Motors Using PWM"**

Authors: Not specified *Published in:* International Research Journal of Engineering and Technology (IRJET), Volume 4, Issue 2, 2017 *Summary:* The paper explores the use of Pulse Width Modulation (PWM) techniques for the synchronization and control of multiple motors, highlighting the advantages of microcontroller-based systems in industrial applications.

- **"Speed Control of 3-Phase Induction Motor using Single Phase Supply and Bluetooth Technology"**

Authors: Engr. Manan Shah *Published in:* Not specified *Summary:* This study investigates the control of a three-phase induction motor powered by a single-phase supply, utilizing Bluetooth technology for wireless speed regulation, and discusses the practical implementation and benefits in industrial settings.

- **"Speed Synchronization of Multiple Motors in Industries using PIC Microcontroller"**

Authors: Ibrar Ayyub *Published in:* PIC Microcontroller Projects, 2023 *Summary:* The project aims to synchronize multiple motors using wireless technology, specifically employing PIC microcontrollers and radio frequency communication, to enhance operational efficiency in industries like textile and steel plants.

3. PROBLEM IDENTIFICATION

To achieve synchronized operations among the motors, speed synchronization becomes essential in many motor applications such as industrial applications. This applies a need for resolving issues that could suffice synchronization challenges:

- ❖ **Differentiations Among Motor Specifications:** At their respective differences in terms of power rating, manufacturing tolerances, load conditions, etc., inconsistencies arise concerning speed and torque outputs, therefore making synchronization difficult.
- ❖ **Control Strategy Limitations:** Traditional control approaches such as parallel or master-slave configurations would fail to adequately respond to disturbance and dynamic shifts, causing loss of synchronization.
- ❖ **Communication Delays and Latencies:** Delays accrue in systems where motors no longer carry signals and rely on wireless communication systems due to signal transmission time, resulting to asynchronous operations of the motors.
- ❖ **Environmental Interference:** The industrial environment is generally very harsh, suffering from such adverse conditions as electromagnetic interference, temperature changes, and obstructions and/or flunkiness in the computer or physical base where such systems are housed, making even wired or wireless communication systems susceptible to the influence of adverse conditions, inviting more or fewer synchronization problems.
- ❖ **Scalability Problems:** The increasing number of motors in such a system increases the complexity associated with synchronization design and maintenance; hence, sophisticated algorithms and communication protocols are necessary.

4. COMPONENTS(TOOLS)

Arduino uno (Microcontroller):

Operating based on temperature, speed, and current inputs to monitor the operation of motor and control it.



Fig.1. Micro Controller

Motor Protection Relay:

Overload Relay:

This prevents the motor from accidentally drawing too much current which could lead to overheating and possibly damaging it.



Fig.2. Overload Relay

Temperature Sensors:

Provides Overheat Protection RTD (Resistance Temperature Detector) or Thermocouple – to observe the temperature of the motor.



Fig.5. Temperature Sensor

Speed and Position Sensors: Ultrasonic sensor

Senses motor shaft speed and is an important input to control systems, protecting against abnormal speeds.

Vibration Sensor (SW420):

It provide a protection from Imbalance in motor and give protection from damaging it.



Fig.5. Vibration Sensor

Power Electronics Components:

Transistor:

Used in soft starters for controlling the voltage and current supplied to the motor.

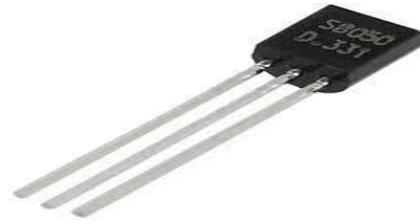


Fig.7. Transistor

Diodes and Rectifiers:

For converting AC to DC in the motor drive system.



Fig.8. Diode

Arduino IDE exe software:

For programming of Micro controller (Arduino uno)

Alarm System:

Provides visual or audible warnings when a fault is detected, such as overload, over-temperature, or phase failure.

5. CONCLUSION AND FUTURE SCOPE

Conclusion:

The precise speed synchronization of multiple motors is vital for coordinated operations and to prevent damage to the products in various industrial applications, such as textile mills, paper mills, and conveyor systems. Conventional methods involving mechanical transmissions can be cumbersome since they involve setup with line shafts, gears, and pulleys, increasing maintenance requirements and lowering flexibility. Wireless technologies come into play in this arena, especially using devices like HC-05 Bluetooth.

The wireless speed synchronization revolves around microcontrollers monitoring the motor speeds of the different setups. The speed of a master motor in a setup is typically transmitted to slave motors that adjust their speeds to maintain synchronization. This approach frees up highly complex wiring and makes the system more scalable. However, limitations exist when it comes to range and interference with industrial power electronics in addition to ensuring real-time performance to maintain integrity.

To conclude, wireless speed synchronization with an HC-05 Bluetooth module stands to be a foremost weaponry to modernize an industrial motor control scheme, which must be carefully studied and evaluated through environmental conditions, system design, and communication protocol strength to reap its benefits.

Future scope:

The future of speeding up sync among multiple motors and motor driven operations in different categories of industrial application through wireless technology like HC-05 Bluetooth module looks very bright and promising in many aspects. It has various avenues in their future:

- **Market Growth and Adoption:** The international wireless motor control systems market is poised for a significant turnaround, and it would cross the estimated value of \$957.3 million by 2032, following the increasing demand for automation and flexible manufacturing processes.
- **Integration with New Age Technologies:** The integration of wireless motor synchronization with IoT and deep analytics would also allow real-time monitoring, predictive maintenance, and energy optimization, thereby enhancing operational efficiency and decision making.
- **Technological Advancements in Wireless Communication:** As the new emerging wireless communication technologies such as 5G, NB-IoT provide higher performance and lower latency and

ensure better reliability for motor synchronization applications they will pave the way for more robust and scalable solutions.

- **Emerging Industries Extension:** New industries such as renewable energy, electric vehicles and smart infrastructure provide wider room for opportunities in wireless motor synchronization solutions, as most of them will need good and flexible motor control systems actually to operate their novel business processes.
- **Focus on security and standardization:** With the increasing penetration of wireless systems in different industries, securing the system robustly and developing standards will certainly go a long way in protecting unauthorized access and providing seamless integration of varied industrial platforms.

6. REFERENCE

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