CONTROLLING A WIRELESS STEPPER MOTOR BY RF TRANSMITTER AND RECEIVER DEVICE USING ARDUINO

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Abstract
According to this study, the main objective is to employ RF communication to control a stepper motor. A radio frequency transmitter and a radio frequency receiver make up the RF (Radio Frequency) communication module. RF transmission is the foundation of the control system. Everything that has to be controlled is done through this system. A pair of RF-transmitter and RF-receiver devices operates the stepper motor. The RF module's function is to use the user's inputs to control the stepper motor. The user-input date is broadcast by the RF-transmitter component, and the date is received by the RF-receiver component. All of these parts are connected by a microcontroller unit, which is built on a PCB (printed circuit board) and that is Arduino. The success of the initiative hinges on three factors: 1) Part of the input 2) Controller component 3) Part of the output.
The RF module, which provides instructions or commands to the controller, makes up the input component. The controller part is made up of a microcontroller unit, which is constructed on a PCB called Arduino. Finally, the Output section includes a stepper motor, which allows the user to adjust the direction and speed of the motor using a set of commands.
Keywords: Arduino, Stepper Motor, RF receiver, RF transmitter, Communication, Frequency.

1. Introduction

The newest contributions to electrical motors are stepper motors. They are inexpensive and reliable since they have minimal moving parts. Despite being very small and low-power in compared to other motors, they are frequently used in automation systems since they are brushless and simple to position.

They lack a horsepower rating because they rotate in stages that are triggered by pulses sent to the stator windings rather than constantly. The motor's speed is managed by changing the pulses' frequency. Robots, telescopes, hard drives, robot antennas, and even toys all use stepper motors to provide precise positioning.

Stepper motors have a high holding torque but cannot run at high speeds. Because it translates digital pulses into set steps, a computer system can easily "step" the rotation of the motor for precise control, astepper motor can be thought of as a "digital" counterpart of an electric motor.

A stepper motor is inexpensive, has simple drive electronics, is precise, has a reasonable holding torque, and runs at moderate speeds. A servo motor, the forerunner of the stepper motor, is required for high acceleration and large loads while maintaining accuracy.

A control system is required to control the stepper motor, and there are wired and wireless control systems available. We can't control the stepper motor over a long distance with a wired control system, and doing so takes time. Furthermore, it has a bigger number of drawbacks than benefits. Wireless communication systems, on the other hand, are frequently used. Infrared connection, Bluetooth, and other technologies are used to control stepper motors wirelessly.

The radio frequency communication system is used for longer range, uninterrupted signals, and better control.

A radio frequency (RF) transmission is a wireless electromagnetic signal that is used as a form of communication in wireless devices. Electromagnetic waves with specific radio frequencies ranging from3 kHz to 300 GHz are known as radio waves.

Frequency refers to the rate of oscillation (of the radio waves.) RF propagation travels at the speed of light and does not rely on the utilization of a medium like air to do so. RF waves are produced by sun flares, lightning, and stars in space that release RF waves as they age. Radio waves, which have been intentionally manufactured and vibrate at various frequencies, are used by humans to communicate. RFcommunication is used in television transmission, radar systems, computer and mobile platform networks, remote control, remote metering/monitoring, and many more

industries.
RF transmission is preferred over IR (infrared) transmission for a variety of reasons. To begin with, RF signals can travel greater distances, making them suitable for long-range applications. RF signals may pass over obstacles between the transmitter and receiver, whereas IR is mostly used in line-of-sight mode. Then there's the fact that radio frequency (RF) communication is stronger and more dependable than infrared (IR). RF transmission has a set frequency, unlike IR communications, which are affected by other IR emitting sources. This RF module includes an RF Transmitter and an RF Receiver. A 434 MHz frequency is used by the transmitter/receiver (Tx/Rx) pair.

RF-Module

An RF module (short for radio-frequency module) is a (typically) small electrical device that allows two devices to send and receive radio signals. It is frequently useful in an embedded system to connect with another device wirelessly. Optical communication or radio-frequency (RF) communicationare two types of communication can be used to carry out this wireless communication. RF is the preferred medium for many applications since it does not need line of sight There is a transmitter and areceiver used in RF communications. They come in a variety of shapes and sizes. Some are capable of transmitting up to 500 feet. RF CMOS technology is commonly used to manufacture RF modules.

RF-Transmitter module

An RF transmitter module is a tiny PCB sub-assembly that can both transmit and modulate radiowaves to carry data. Transmitter modules are often used in combination with a microcontroller, which feeds data to the module for transmission. The maximum permitted transmitter power output, harmonics, and band edge criteria are normally governed by regulatory standards for RF transmitters.

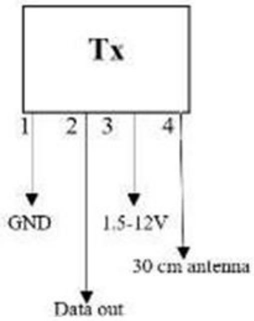

Fig-1: Pin diagram of Transmitter module.

RF-Receiver module

The modulated RF signal is received by an RF receiver module, which demodulates it. Superheterodyne receivers and Super-regenerative receivers are the two types of RF receiver modules. Super-regenerative modules are typically low-cost, low-power devices that extract modulated data from a carrier wave via a series of amplifiers. Because the frequency of operation of Super-regenerative modules varies greatly with temperature and power supply voltage, they are often imprecise.
Super heterodyne receivers outperform Super-regenerative receivers in terms of accuracy and stability across a wide voltage and temperature range. A fixed crystal design provides this steadiness, which has traditionally meant a more expensive device.

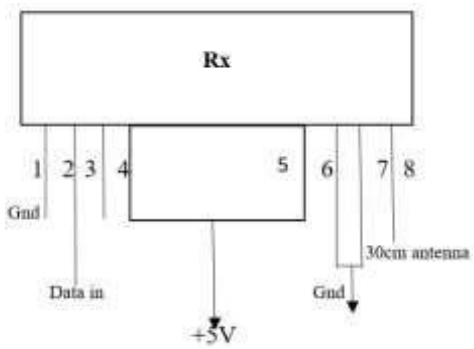

Fig-2: Pin diagram of Receiver module.

However, thanks to advancements in receiver chip design, the price difference between superheterodyneand Super-regenerative receiver modules is now minimal.

2. Model and Function

We'll need to create a block diagram to make this project work. This block diagram is dividedinto two sections: -

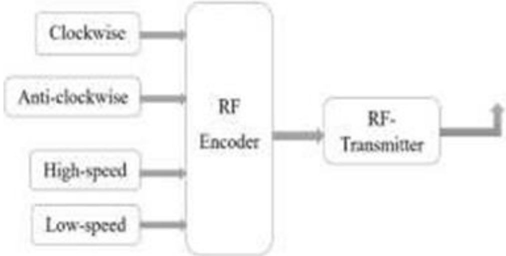

Fig-3: Input section

The model in this first section consists of an input module that transmits data including commandsissued by the user. The receiver portion receives these commands. i.e., the model's output module.

The commands are as follows:

1) In a clockwise manner
2) In the anticlockwise direction
3) Extremely fast
4) Slow movement

These are the instructions for controlling the stepper motor.

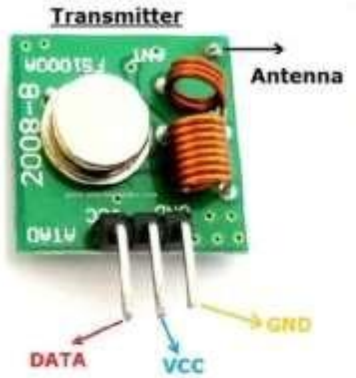

Fig-4: RF-Transmitter

We can control the stepper motor in the manner that the user desires using this input section.

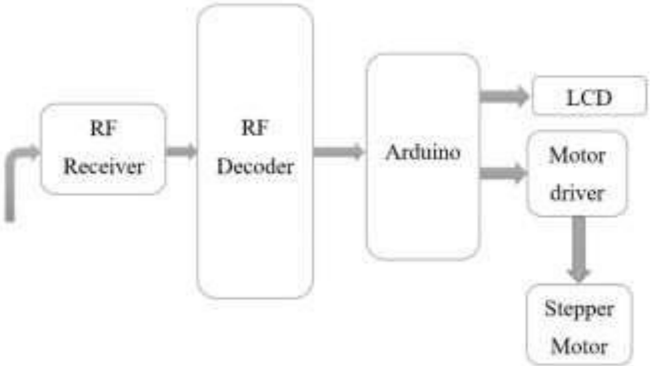

Fig-5: Output section

The data sent by the input section is received by the output section.

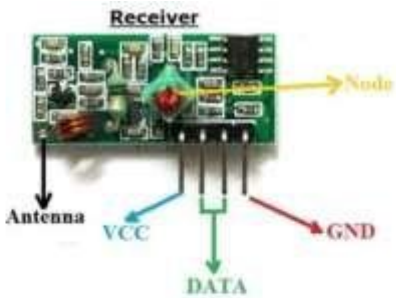

Fig-6: RF-Receiver

Arduino, LCD, motor driver, RF receiver, and stepper motor are included in the output.The data that is received will be processed by Arduino. i.e., microcontroller.

Fig-7: Arduino Uno

The data will be processed by the microcontroller, and all of the other components that will operate themotor will be linked to the controller.

Fig-8: LCD Screen

The controller is coupled to the LCD, motor driver, and stepper motor. The LCD (liquid crystal display)that will show the stepper motor's direction and speed.

The LCD also displays the commands that are delivered by the user.

Fig-9: I2C Module

The I2C module is used to prevent dots from appearing on the display. It has four ports: 1) GND, 2)VCC, 3) SDA, 4) SCL.

I2C is used to connect the LCD driver module. The stepper motor is controlled by a motor driver.

Fig-9: Motor Driver

To appropriately operate the motor, a motor driver amplifies the low-current signal from the controllercircuit into a high-current signal. It simply uses a low-current signal to regulate a high-current signal. The Motor Driver is a motor control module that lets you control the speed and direction of two motorsat the same time.

The commands received from the transmitter will be processed by Arduino and used to operate themotor through the motor driver using these components.

The LCD's function is to show the commands entered by the user.

Fig-10: Stepper Motor

That's how the motor will work according to commands given by user.

3. Result

From this project, the following conclusions may be drawn. The ability to control the motor's direction, either clockwise or anticlockwise, as well as its maximum speed, has been accomplished. The signal is conveyed even if a barrier is placed between the sending and receiving sides, obstructing the transmission. The clockwise and anticlockwise motions of the motor are regulated in a predetermined manner. Attaching a weight to the motor's end allows you to see the direction and speed. Finally, we must state that the project was a success, and we tried our best to make it the best it could be.

Fig -11: Final view of the project.

Conclusion

The stepper motor is controlled wirelessly, which is safer and more advantageous; additionally, this project is very useful in comparison to existing systems that use DC motors, which do not have high accuracy and precision; and finally, this project can be modified with IOT to control the machine from a remote location. RF communication is superior to IR communication in several ways, including greater range and powerful communication. The input component is the RF module, which gives the controller instructions or orders. The Arduino microcontroller unit, which is built on a PCB, makes up the controller portion. Lastly, a stepper motor is present in the output area, allowing the user to modify the motor's direction and speed using a set of commands.

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