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DESIGN AND IMPLEMENTATION OF UNIVERSAL MOTOR CONTROL USING IR REMOTE AND ARDUINO

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Abstract - The main objective in the paper is to control on DC motors due to its significant advantages over other types of machine drives. In industry, DC motor is widely uses for speed control and load characteristics. This research paper shows the methodology to interface stepper, servo and DC motor on a single platform. IR (Infrared remote control) is implemented to control all motors. Speed of DC motor is controlled by IR remote and H -BRIDGE respectively. Stepper motor is controlled by ULN2003 current driver and servo motor is controlled by Arduino controller. In a nut shell, all the motors are controlled using IR remote and Arduino controller.

Keywords: Design; implementation; control; universal; motor based calibration; computer; study; architecture; Arduino Controller;

I. INTRODUCTION

The control of universal motors can be easily done by electrical drives. Electrical drive makes the motion of the electrical machines. The assembly of an electric motor with a sophisticated system is called typical drive system. Therefore, the control process can be done easily with wireless system nowadays. So, the motor controlling system becomes more and more accurate and it is required to use everywhere. To do that, motor driver circuit is used getting higher current control signal from low current control signal that the motor required. The system composed of various types of motor, L298 H-Bridge motor drive, ULN2003 and Infrared remote. The main controller used in is Arduino Uno.

II. MOTORS IN SYSTEM

There are various designs of DC motors. Among them, three types of motors such as simple DC, stepper and servo motors are used in this research paper.

DC Motor

In this research, RF-300 FA-12350 dc motor is used which output is 0.02W to 0.6W and is 3V.Typical Applications is in audio and visual equipment. A stator, an armature, a rotor and a commutator with brushes are composed of making a simple DC motor. It can be turned on by opposing polarity between the two magnet fields inside.

Fig.1 Pinout Diagram of DC Motor

Stepper Motor

In this research, 28BYJ-48 stepper motor is used which is shown in Fig 2. Stepper motors are type of DC motors. With Arduino controlled stepping, it can achieve very precise positioning and/or speed control as it move in discrete steps. A stepper motor converts digital pulses into mechanical shaft rotation because its normal shaft motion consists of discrete angular movements of essentially uniform magnitude when driven from sequentially switched DC power supply.

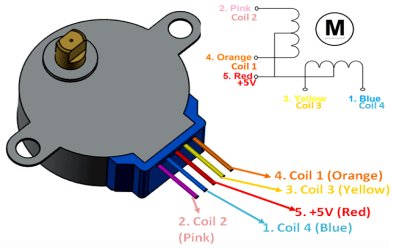

Fig. 2 Pinout Diagram of Stepper Motor

Servo Motor

In this paper, SG-90 servo motor is used because of its small-size, cost-effective and can be rotated 0°-180°.Its operate voltage is +5V typically and can speed up of 0.1s/60° It contains a big punch which is very energy-efficient. So, it can be operated by controlling remote or radio and other wireless signal. The movement of the shaft in servo motor is controlled with an electric signal.

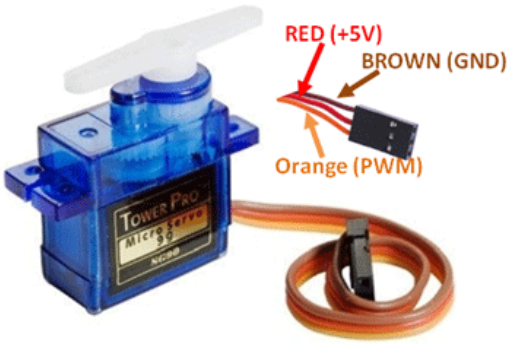

Fig. 3 Servo Motor

III. METHODOLOGY IN SYSTEM

There are three functional blocks in this research. They are IR remote, Arduino controller and motor drivers. Thus the Arduino Board is programmed using the Arduino IDE software. The function of the IR remote is to communicate digital signal pulses to Arduio. This research uses Arduino Uno to controls the two motor drives which are L298 and ULN2003. Follow the schematic to connect the Arduino to the motor driver, and drive to the DC motor and stepper motor. L298 and DC motor are driven by a 12 volt power supply. Moreover, ULN2003 and stepper motor are also driven by 12 volt power supply. Servo motor directly connected to Arduino and power supply is only 5V.

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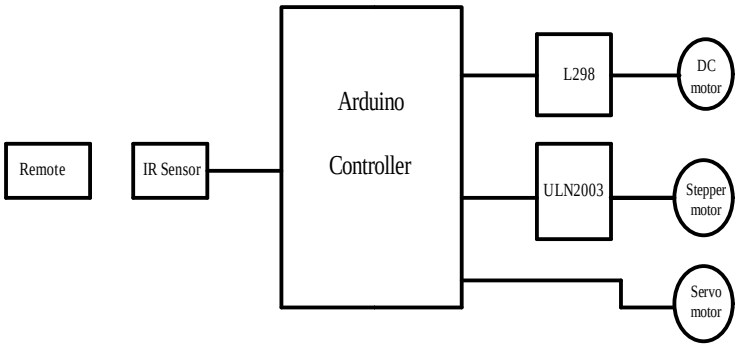

Fig. 4 Block Diagram of System

IV. IR REMOTE

Infrared (IR) remote system can be controlled simple dc motor, stepper motor and servo by implementing wireless technology. It contains an IR transmitter and an IR receiver. Infrared radiation is a form of light similar to the light which all around us. The frequency and wavelength of visible spectrum and Infrared light is described in Fig.5.

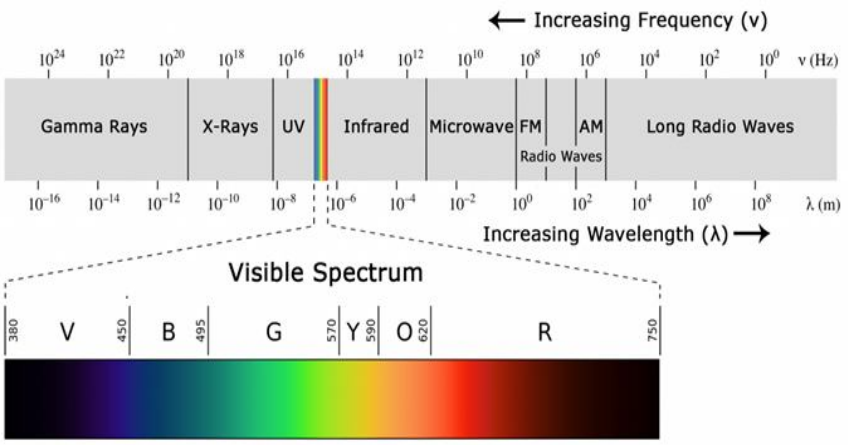

Fig.5 Spectrum of Light

The transmitter produces light in the IR spectrum instead of the visible spectrum. The IR receiver converts the IR light into an electrical signal. Fig.6 is a typical IR receiver module and its transmitter.

Fig. 6 IR Receiver and Transmitter

Conversion to a modulated electrical signal from a binary signal is made by IR remote encoder. When electrical signal is reached on the transmitting LED, its converts The transmitting LED converts the modulated electrical signal into a modulated IR light signal by signal modulation. And then the IR light signal is converted into binary before passing on the information to Arduino by IR receiver.

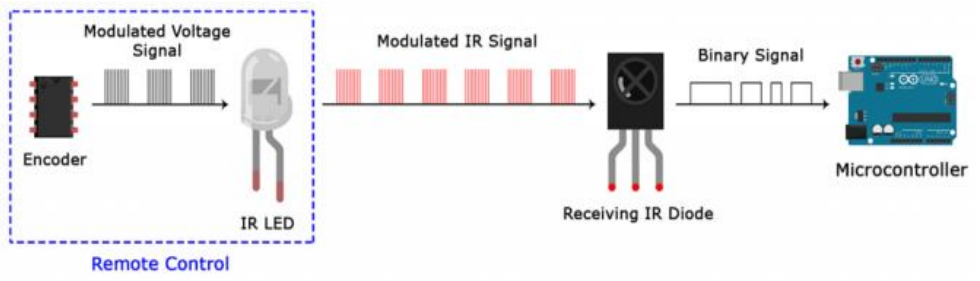

Fig.7 IR Signal Modulation

In this research, the carrier frequency used by transmitters is 38 kHz, because it is rare in nature and thus can be distinguished from ambient noise. This way the IR receiver will know that the 38 kHz signal was sent from the transmitter and not picked up from the surrounding environment. Each time press a button on the remote control, a unique hexadecimal code is generated. This is the information that is modulated and sent over IR to the receiver. In order to decipher which key is pressed, the receiving Arduino needs to know which code corresponds to each key on the remote.

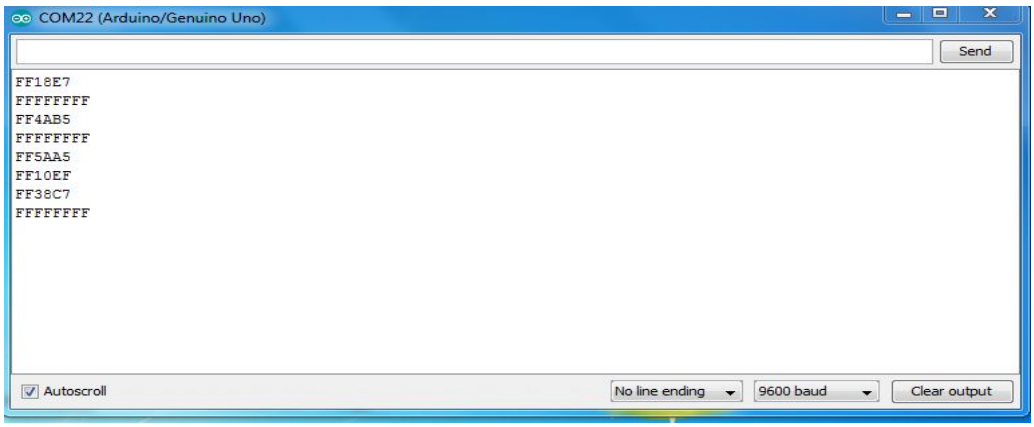

Fig.8 Hexadecimal Code from Experiment

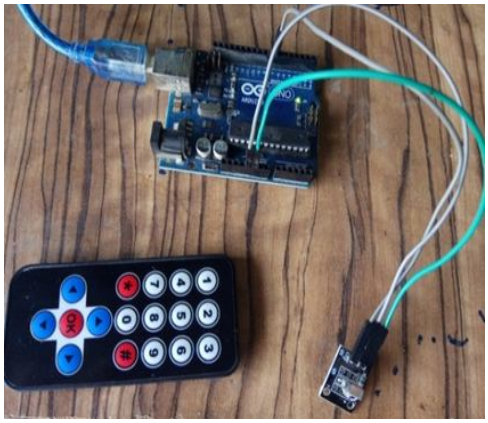

Fig.9 Hexadecimal Code with Hardware Design

The NEC protocol is also the most common type in Arduino projects. Press each key on remote and record the hexadecimal code printed for each key press. In this research, hexadecimal codes for dc motor, servo motor and stepper gets from practical hardware test. It derived a table of keys and their corresponding codes from the remote that came with IR receiver and remote set.

V. ARDUINO UNO

In this research, Arduino is used to communicate with IR remote, another L298N motor driver and ULN2003 motor driver for motor control. The platform of Arduino Uno is based on 8-bit ATmega328P. It contains a power barrel jack, a reset button and ICSP. It can be read the inputs such as a Twitter message, a finger on a button, and light on a sensor and can be turned it into an output such as switching on an LED, activating a motor and publishing something online. Among the range of modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more, the research paper used Arduino Uno because of consisting crystal oscillator, serial communication, and voltage regulator to support the microcontroller. The sketch can be created on IDE platform generating Hex File which is transformed and uploaded in the controller on the board. Its language is both C and C++. The reason why it is used in this research paper is that Arduino Uno is very cheaper than any other board and it is a low voltage device. Technical specifications are followings.

TECHNICAL SPECIFICATIONS

Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

VI. ULN2003

In this research, ULN2003 stepper motor driver is used because it can drive high current motor which specifies within 9V and 300mA.It has 16 pins and any other SOP, PDIP, TSSOP, or SOIC to do multiple functions. Its size is compact as transistor circuit. High DC voltage of maxima 50V is used by ULN2003. The handling current of each input pin is also 500mA. It consists of an internal clap diode for back EMF protection. For inductive load, it consists of a pin and an internal fly back system protection. Its power consumption is very less and can be used any power source unattached directly to it. Hardware and pin configuration are followings.

In this research, L298N motor driver is used to control DC motor speed. A high voltage, high current, dual full-bridge driver is designed. Two enable inputs are provided to Enable or Disable the device independently of the input signals.

Fig.10 ULN 2003 BoardFig.11 L298N Motor Driver

VII. CIRCUIT DIAGRAM OF SYSTEM

Different types of motors are interfaced with Arduino using Digital pins which are then controlled by IR remote. Interfacing is done along with different control drivers. All this together forms motor drivers and motors. A power supply is also separately provided. First DC motor is connected to pin 2 & pin 3 of L298 driver; second stepper motor is connected to 13,14,15,16 number pins of ULN2003 driver. DC motor is controlled by L298 whose ENABLE pin is connected to pin 12 of Arduino. Pulse to Servo motor is given from pin 7 of Arduino. Stepper motor utilizes 8 9 10 & 11 pin on Arduino Board. Also the controlling of whole application through IR remote occupies pin number 6 of Arduino.

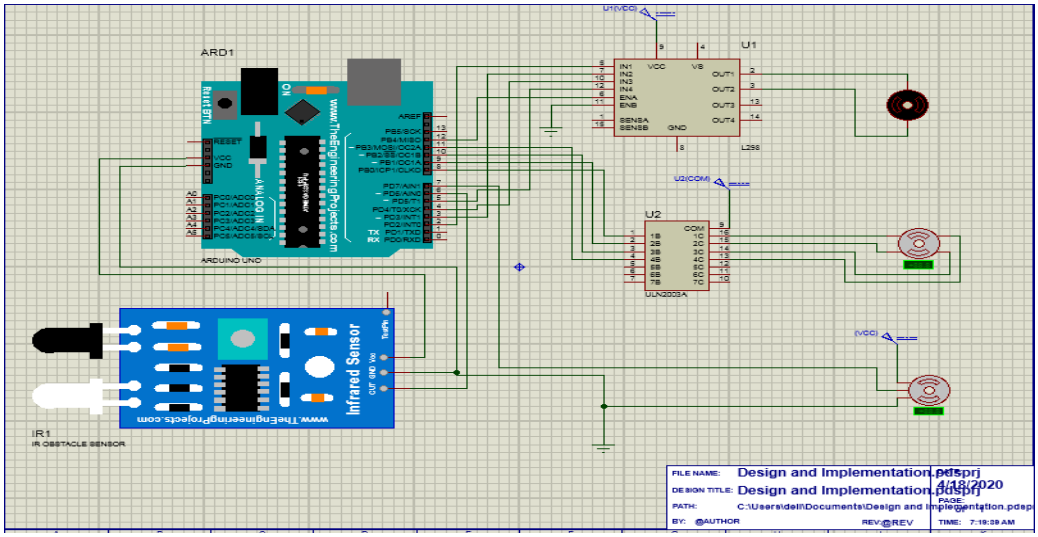

Fig. 12 Circuit Connections of System

VIII. HARDWARE IMPLEMENTATION

IN 1 and IN 2 of L298 motor driver are used to control the direction DC motor. ENA and ENB are connected to PWM pin to be able to control of DC motor speed. The hexadecimal code of IR controller for up button is 0x00FF18E7 and down button is 0x00FF4A5B as shown in Fig. 13.These hexadecimal codes are used to control of DC motor. The hexadecimal code of IR controller for left button is 0x00FF5AA5 and right button is 0x00FF10EFas previously described in Fig. 8. These hexadecimal codes are used to control of stepper motor. The hexadecimal code of IR controller for servo motor is 0x00FF38C7. Finally, it is readily used for controlling purpose but this is not the only advantage of electrical drives. This Universal Drive can be used to reduce the hardware cost and space. This drive can provide variation in speed and power. The control characteristics of this drive are flexible.

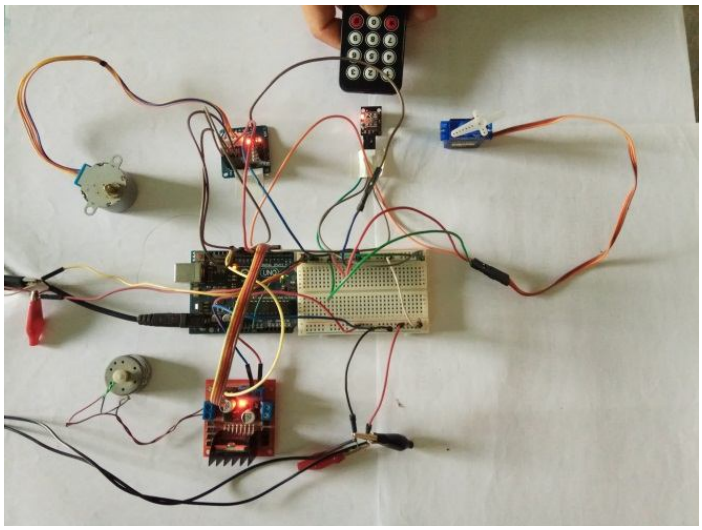

Fig. 13 Hardware Test

IX. CONCLUSION

From the research it can be concluded that the system can drive different motors such as DC motors, stepper motor and a servo motor using the single hardware unit. Actually, the system is very simple, less power consumption, cost-effective and compatible because of operating under different atmospheric conditions using IR remote.IR communication, most useful application, is implemented in this system for wireless technology. Thus, the system is very suitable for reliable equipment to control different sets of motors.

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