Wireless Servo Motor Control using RF and MCU

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Abstract- Servo motors or stepper motors are very common in day to day gadgets. Almost every bidirectional rotating mechanism is based on servo motor. These servo motors are controlled either via wired system or via wireless system. This technology is used everywhere for example the wiper system of automobiles. Also the analogue speedometers were based on this technology. Home automation is a very important sector in 21st century. Countless home automation projects can be done using this servo motor control technique. Feedback control system is the backbone of IOT (Internet Of Things) or IOE (Internet Of Everything) as coined by CISCO. The servo basically works on feedback control system. The operation of feedback in servo can be designed in MATLAB but on an industrial level. This paper deals with a very general extremely low cost method for the wireless control of servo.

Keywords: *arduino, servo motor, PWM, atmega, RF module, home automation, IOT, IOE.*

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I. INTRODUCTION:

A servo motor or a stepper motor is basically a DC motor having internal gears and a very precise shaft. The shaft can be positioned at several different angles starting from 0 to 180 degree. The technique used is position control technique [3]. Previously papers have been published in IEEE and IET on this motor control technique but all of them were on industrial level [5]. This paper is mainly based on servo motor control [6] using very simple market available modules. The stepper motor is controlled by radio frequency which is one of the standard means of communication [2]. The stepper control system is coded using the Atmega328 microcontroller but it can also be controlled using an 8051 microcontroller and also by any other controlling system [3]. The control pulse is PWM and is a square wave but higher order waves are also generated using Multilevel Inverter Technology [1].

II. TECHNICAL DETAILS:

Unlike normal DC motors servo motors have 3 terminals. The third terminal is the control terminal where the control signal is provided. The control signal is mainly a PWM (Pulse Width Modulation) signal. The PWM can be produced by analogue circuit or by using a MCU of specific duty cycle. The MCU can be of any type with a suitable development board. The MCU must be such selected that it is able to produce the selected PWM frequency. In the MCU the code is such written to produce the perfect pulse. For the wireless transmission system we use Radio Frequency of allowable frequency (434 MHz). The said frequency is under allowable limits by Government of India which neither disturbs ATC (Air Traffic Control) nor the walky talky used by police. The module used in the project is a commercially available readymade module. The data is encoded and decoded by two set ICs which are also commercially available. Then the signal is interfaced with MCU which produces the control signal. There are 4 switch attached to the transmitter pair which send 4 different digital signals. The MCU recognizes the signal and acts accordingly. The signals are first encoded and sent via RF. After receiving the signals are decoded as per set protocol and the servo motor acts accordingly. The PWM generated can be simulated using specific software. The MCU development board can be made using specific standalone circuit models. The MCU used here is ATMEGA 328 by Atmel. The board is made by interfacing a clock crystal with capacitor coupled along with specific voltage supplies. The MCU is coded using AVR language by a burner interfaced via MOSI MISO ports. Being a full duplex form of communication the RF inputs can also be tracked. The PWM signal generated can be shown as as square wave of specific duty cycle.

III. BLOCK DIAGRAM:

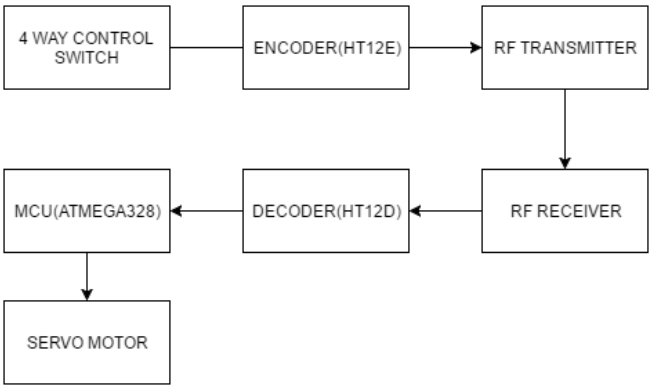

Fig. 1 Block diagram of system

The HT12E and HT12D are commercially available IC for RF data transmission and coding. The MCU board along with the RF module is shown below. This is a prototype of the total control unit:

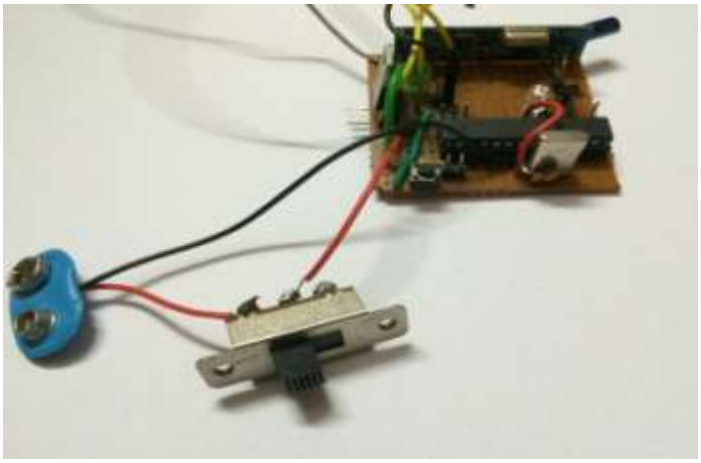

Fig. 2 Prototype of the system

The system runs on a 9V DC battery. It also works on 5V supply if provided directly to the MCU.

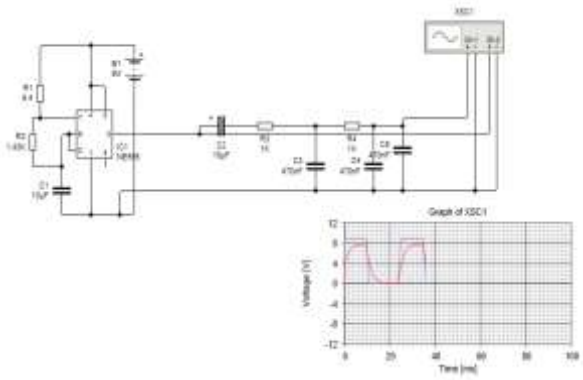

Fig. 3 Real time PWM simulation

IV. RESULTS AND ANALYSIS:

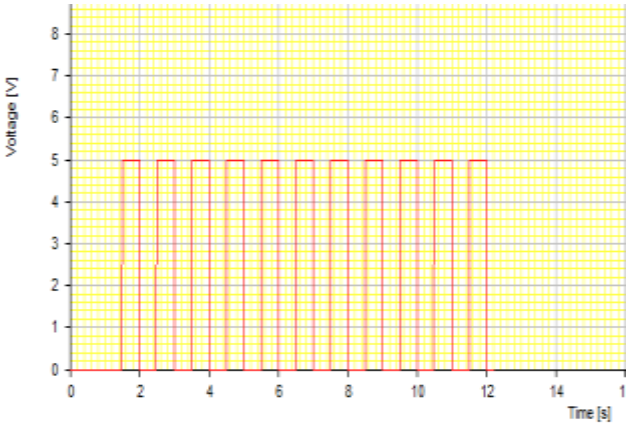

Fig. 4 PWM of 50% duty cycle

The given picture is a screenshot from simulation. Two signals one square wave and another triangle wave are shown in the graph. The square wave is of 50Hz frequency and is made using 555 timer in astable multivibration operation. By adjusting the resistance value and capacitance value the duty cycle and frequency can be changed. Fig.no.4 is a real time simulation graph with 50% duty cycle. There are many applications of a servo motor namely:

- Industrial automation
- Robotics
- Solar tracking system
- Defense

Wireless servo motor controlled can be used if the control unit is far away from the system. The exact use of this technology can be found in drones and quadcopters.

When used with wire, a servo motor shield can also be used to control the signals.

V. CONCLUSION:

The servo controlling system can be controlled wirelessly very easily using this RF module and MCU. This thing can be made in home using some simple steps and calculations and can be used for several home automation projects involving door opening and closing via mobile phones over Wi-Fi or Bluetooth communication. Any project involving wireless high precession control of motors can be done using these techniques. The atmega chip supports serial communications so data can also be send from the user end to the servo motor. As per the simulation circuit if MCU is unavailable then also using a 555 timer the motor can be controlled though it involves a much complex circuit and also the communication is harder since normal analogue signals over the RF produces noise. On that note we can add a suitable band pass filter to adjust the signal.

VI. APPENDIX:

IC used in simulation: 555 timer IC
Frequency: 50 Hz

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