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A Remote-Controlled Unipolar Stepper Motor Using RF Module

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Abstract- *A remote-controlled stepper motor using RF module was designed and simulated. This design of remote-controlled stepper motor consists of mobile section and a static section. The mobile section comprises of a keypad connected to microcontroller with Liquid Crystal Display (LCD) display. The keypad is used to input the stepper angle and the signals are been sent to the microcontroller that converts these signals to a serial data and transmits them via Transmitter (TX) module. While the static section has a Receiver (RX) module that continuously scan for the signals from TX. Upon receiving the transmitted serial signal the RX module send it to the microcontroller at the static section to decode these signals and turns the stepper motor to the appropriate angle via stepper motor driver. The results from the simulations show that stepper can be controlled remotely using RF module.*

Keywords*:* RF (TX and RX) module, LCD, microcontrollers, stepper motor driver, stepper motor.

1. INTRODUCTION

Stepper motors as their name suggest move 'step' a little bit at a time. They produce the highest torque at low speed. They are completely different from a DC motor which produces low torque at low speed. Furthermore, stepper motors have 'holding torque' characteristics which are not present in DC motors. Holding torque allows a stepper motor to hold its position firmly when it is not turning. Stepper motors are presently being used extensively over a wide range of application. Generally, they are used in microcomputer, office and factory automation application and now they are widely used in robotics. Stepper motors are ideal incremental actuators for digital control system which can be run in open loop mode with sufficient accuracy. They can be controlled directly by computers, microprocessors or programmable digital controllers, unlike most electric motors; they can be viewed as electric motor without commutators. This project sets out to remotely control stepper motor by inputting the stepper angle through keypad.

II. MATERIALS AND METHODS

The Block diagram of the remote-controlled stepper motor system is shown in Figure 1. The remote-controlled stepper motor system comprises of a mobile section and a static section. The mobile section comprises of a keypad where the inputted stepper angles are typed, the microcontroller process this typed angles into serial signal, the LCD displays the typed stepper angles and the TX module transmits the serial signals. The static section comprises of the Rx module which scans for and receives the transmitted signals, the second microcontroller which decodes the serial signals received by the RX module and unipolar stepper motor driver that buffer the current to drive the stepper motor.

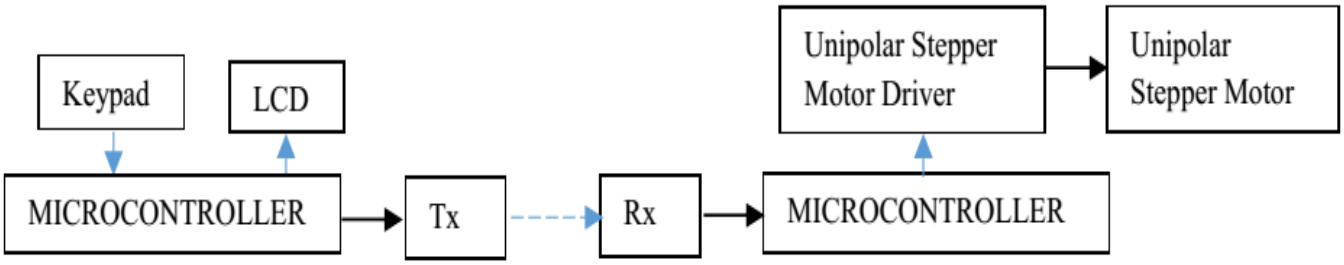


Figure 1: Block Diagram of RF Controlled Unipolar Stepper Motor.

This **RF module** comprises an **RF Transmitter** and an **RF Receiver**. The transmitter/receiver (Tx/Rx) pair operates at a frequency of **434 MHz.** An RF transmitter receives serial data and transmits it wirelessly through its antenna and the RF receiver receives this serial data transmitted by the RF transmitter wirelessly and then sends the data to a decoder. Transmission in the RF module occurs at the rate of 1Kbps to 10Kbps [1]. Figure 2 shows the RF module used in this project.

Figure 2: Transmitter and Receiver with RF Module Pin Diagram [1].

Figure 3 shows the circuit diagram of the remote-controlled stepper motor system. The angle is inputted using the keypad which is connected to port D of the pic18f4550 microcontroller [2]. The microcontroller generates a serial data for the inputted stepper angle and transmits this serial data to the static section via TX module connected to pin 5 of port C of pic18f4550 microcontroller. The inputted angle is displayed on the LCD connected to port D of pic18f4550 microcontroller. The Rx section of the RF module is connected to another microcontroller pic18f2550 [2]. The pic18f2550 decodes the serial data receives by the Rx from the transmitted information and turns the unipolar stepper motor [3] to that angle via UNL2003 stepper motor driver [4]. The flowchart of the program for the system is shown in figure 4. The description of how the system flowchart works is divided into two sections; the TX flowchart in figure 4a and the RX flowchart in figure 4b. The TX begins with initialization and waits for stepper angle to be inputted. If the typed angle is not correct it continues to wait for the correct angle to be typed. But if the correct stepper angle is typed, the typed angle is display on the LCD and the angle is serially transmitted via TX module. Figure 4b describes the receiving section. After initialization it scans for transmitted information. If it finds any, it decodes the serial signal and turns the stepper with respect to the transmitted signal received. Using this flowchart, a program was written and simulated in mikroC integrated development environment (IDE) [5]. Proteus 8.4 [6] was used to simulate the hardware of the system and the state of each stepper motor steps is shown in Table 1.

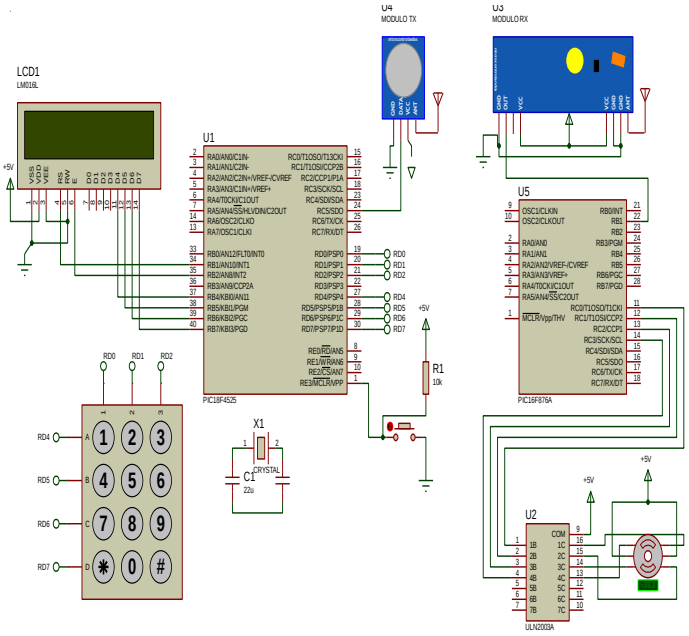
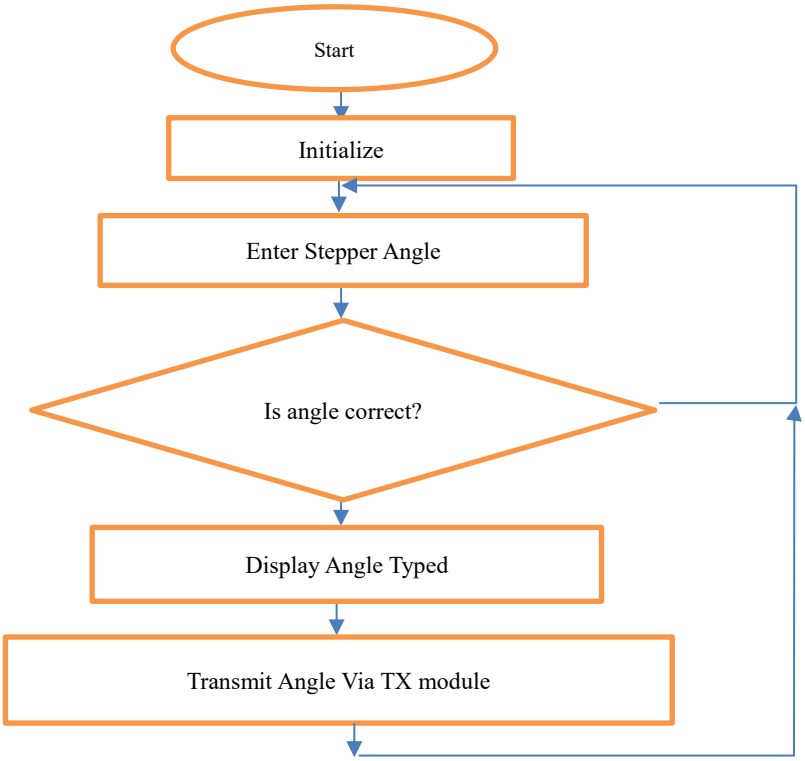


Figure 3: Circuit diagram of the Remote-Controlled Stepper Motor

(a): Transmitter Flowchart



(b): Receiver Flowchart

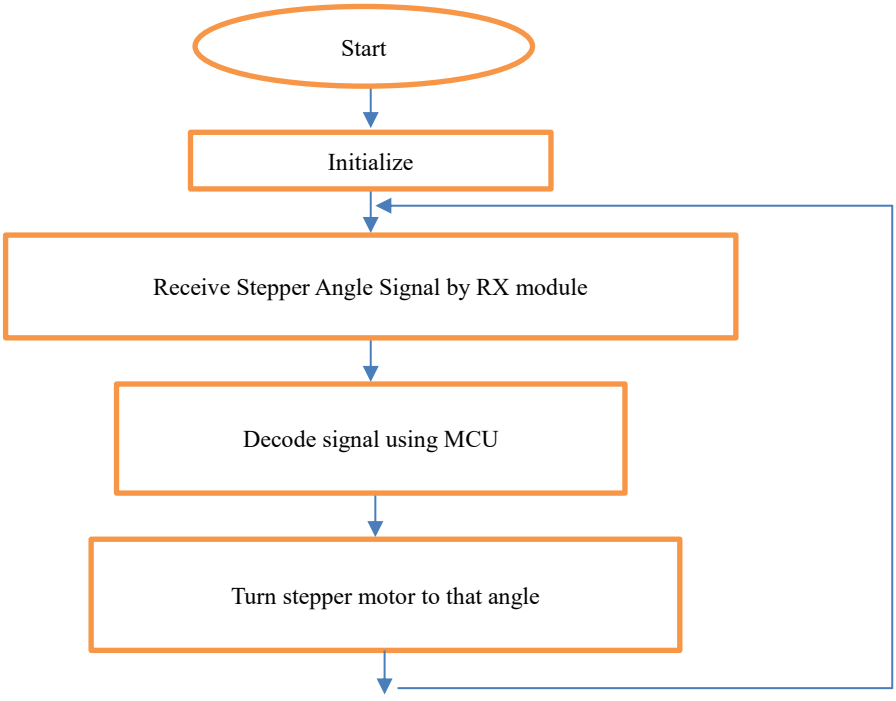


Figure 4: Flowchart of the Remote-Controlled Stepper Motor

Table 1: Stepper angles typed with their corresponding stepper angles moved

TRUTH TABLE					
A	B	C	D	DEGREE	-DEGREE
1	1	0	0	0	0
1	1	1	0	45	-315
0	1	1	0	90	-270
0	0	1	0	135	-225
0	0	1	1	180	-180
1	0	1	1	225	-135
1	0	0	1	270	-90
1	0	0	0	315	-45

3 RESULTS AND DISCUSSION

Figures 5 to 12 show the proteus simulation results of the remote-controlled stepper motor controller system. Figure 5 shows the initialization process of the system. Figure 6, 7, 8, 9, 10, 11 and 12 shows when stepper angles 15, 75, 135, 180, 270, 330 and 360˚are inputted as displayed on the LCD and their corresponding steps by the stepper motor 15, 75, 135, 180, 270, 330 and 360 respectively.

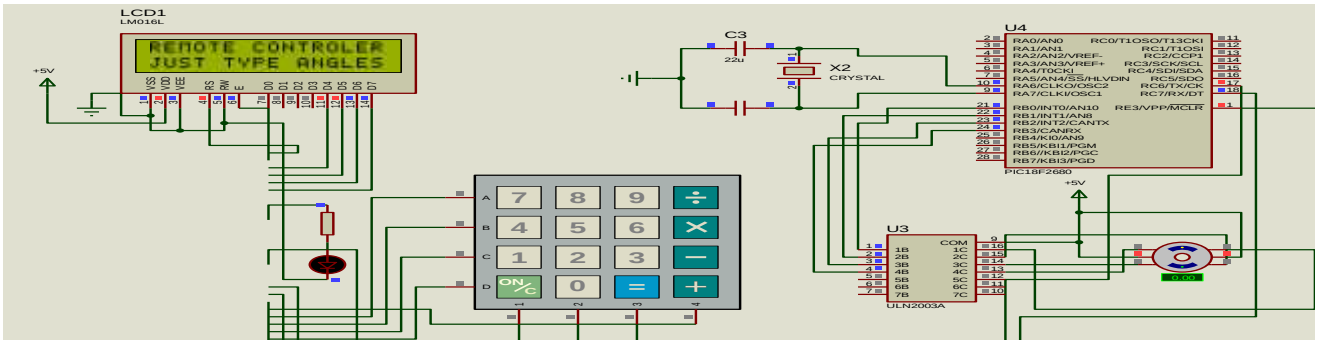


Figure 5: After initialization

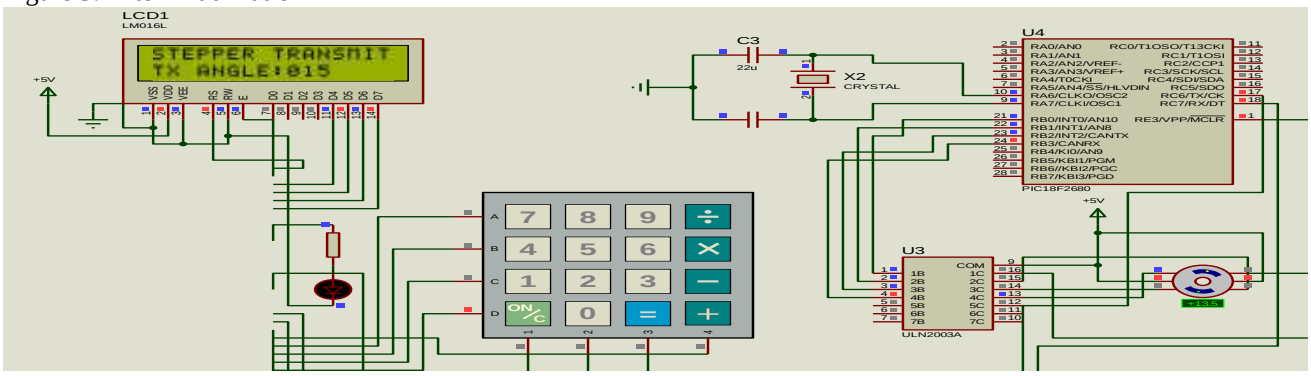


Figure 6: When 15˚ is typed

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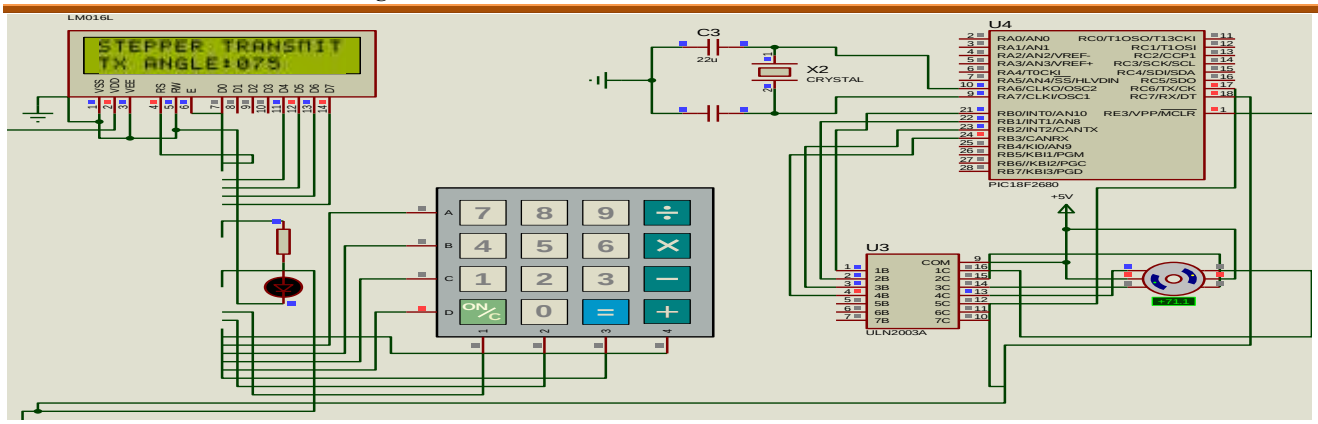

Figure 7: When 75° is typed

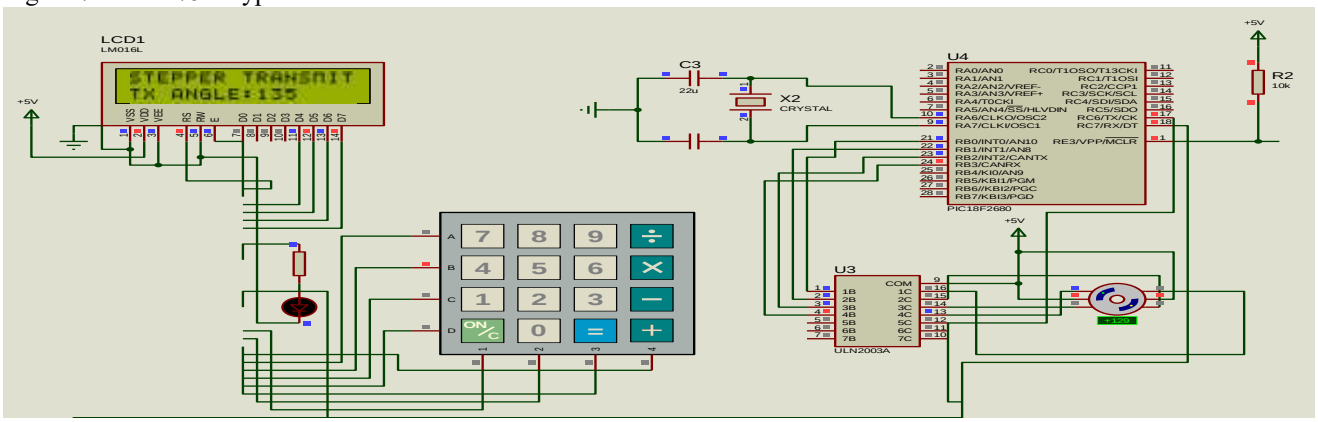

Figure 8: When 135° is typed

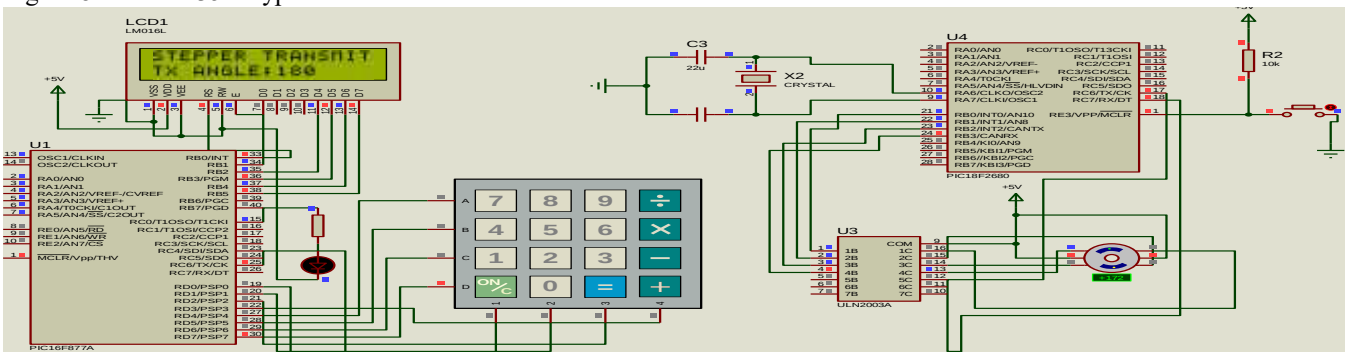

Figure 9: When 180° is typed

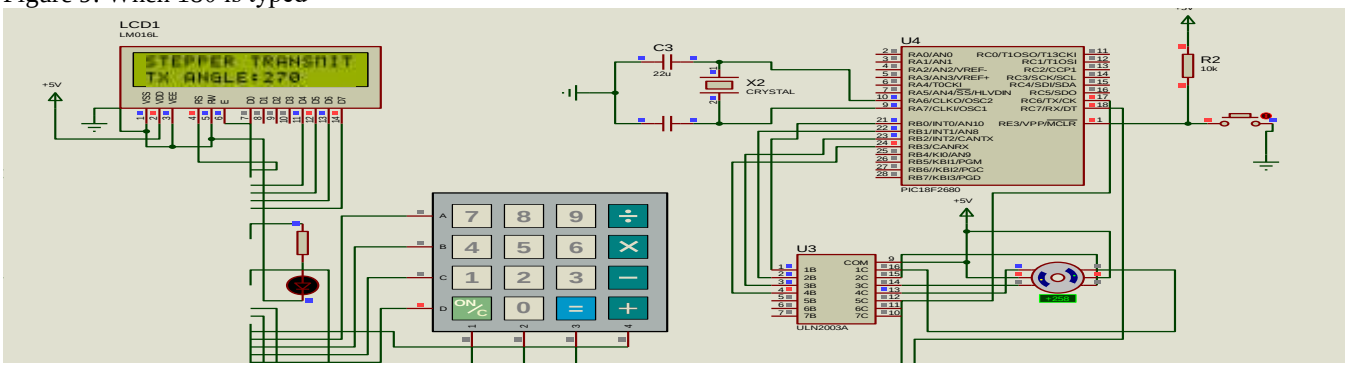

Figure 10: When 270° is typed

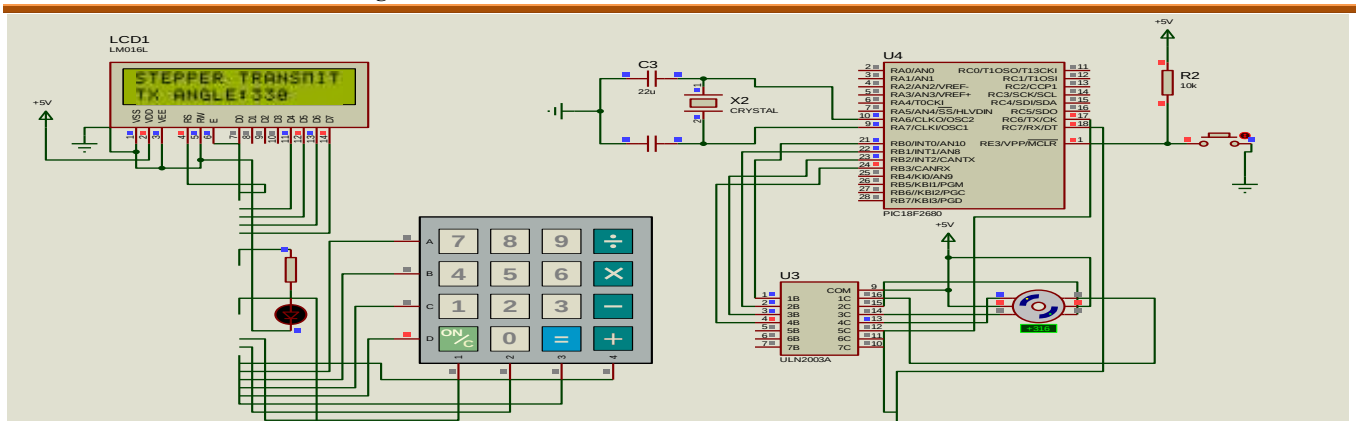

Figure 11: When 330̊ is typed

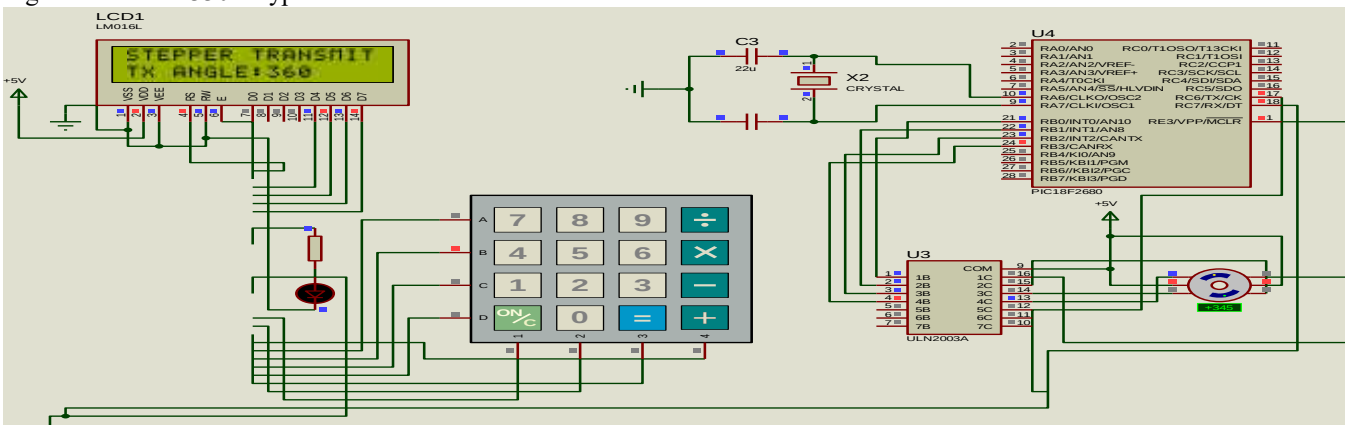

Figure 12: When 360̊ is typed

4. Conclusion

The remote-controlled stepper motor using RF module was designed and simulated. The stepper motor was controlled from a distance and the design work well as long as the RF module is within the distance range. The simulation results for various angles were achieved.

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