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LabVIEW controlled antenna positioner

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ABSTRACT

An antenna rotator is a device used to change the orientation, within the horizontal plane, of a directional antenna. Most antenna rotators have two parts, the rotator unit and the controller. The most commonly available antenna positioners are commercial rotators and sometimes some rotators are even complex to design and operate. Typically, Antenna Positioners are used to align larger antennas such as those used in Satellite Ground Stations to a fixed position. In contrast, Antenna Rotators and Antenna Rotating & Positioning Equipment are used for positioning of UHF/VHF communication antennas. The proposed design includes an azimuthal and elevation angle rotation system and is also capable of moving up to accuracy of 1.8 to 0.9 degrees per step. The design also includes a user interface which is useful for easy control of the antenna positioner. NSI-MI Technologies rotary positioners are engineered to provide the optimum balance of outstanding performance, maximum power-density, and excellent application flexibility. In the center of the reference picture, the accompanying image includes an Az-El installation rotator, so named for its controlling of both the azimuth and the elevation components of the direction of an antenna system or array. Such antenna configurations are used in, for example, amateur-radio satellite or moon-bounce communications. ARA offers an ever-expanding line of positioning systems designed to satisfy the most demanding applications, including integrated antenna systems and RF systems. ARA positioning systems have been used successfully in both military and civilian systems and are successfully installed in ground- based, shipboard and airborne applications. The current rotator or positioner design aims to make use of light weight payloads. In HAM radio applications, generally small weight antennas such as Yagi antennas, stacked Yagi antennas, antenna arrays, testing of microstrip antennas and some RF chamber applications. This small-scale antenna positioner can be used for both indoor and outdoor applications. The indoor applications may like testing od antenna in the RF chambers and the outdoor applications involve satellite communications, weather image tracking etc., and these outdoor applications are the most important in all.

Keywords— *Antenna positioners, VHF/UHF Antennas, azimuthal and elevation angles, UI-User Interface, RF chamber, ground stations*

1. INTRODUCTION

This paper majorly discusses about the antenna positioners in real time. Antenna positioners play a major role in ground stations where we need to communicate to the space-crafts and satellites by transmitting and receiving high frequency radio waves. Similarly, antenna positioners also play a major role in radar as there might be a requirement of scanning mode or fixed position mode where the radar antenna is to positioned in a particular direction. However, antenna positioner is used to put the antenna in position where it achieves line of sight i.e. a straight line along which an observer has unobstructed vision. In radio communication the line of sight plays a major role. Line of sight will increase the chances of receiving or transmitting radio signals without any distortion or loss of data. Alongside, antenna positioners are widely used in anechoic chambers for testing of the antennas. Most of the times these antennas are directional antenna and the need to be positioned in a particular direction to achieve a successful testing of the antenna under test. Another interesting field where antennas and antenna positioners are required is HAM Radios. Amateur radio, also known as HAM Radio, is the use of radio frequency spectrum for purposes of non-commercial exchange of messages, wireless experimentation, self-training, private recreation, radio sport, contesting, and emergency communication. However, the existing systems of the antenna positioners might not encourage an operator to have one for themselves because of the price factor and most of the times it also not easy to carry such heavy and complex system to places and most of the times the price factor does not encourage them to do so. Hence, a cheaper and flexible solution is required and without compromising for the basic functionalities of features.

2. IMPLEMENTATION

2.1 Block Diagram

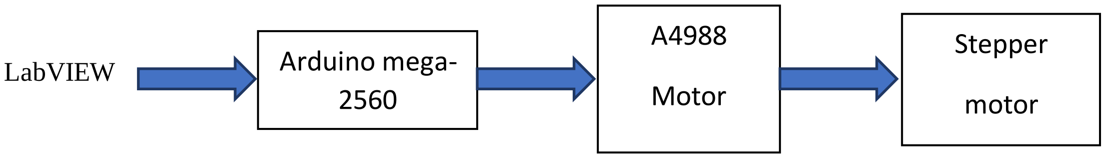

Fig. 1: Block Diagram

(a) LabVIEW: LabVIEW is a product of National Instruments (NI). It requires licenses, although student and trial packages are available. You can learn more about LabVIEW at the LabVIEW Maker Hub. A student edition was used for this article. Files created have a file type of *.vi. Installed, LabVIEW presents an integrated development, test and run environment. LabVIEW was designed to support a laboratory environment and is targeted to applications to control and monitor equipment.

(b) ARDUINO MEGA-2560: Arduino MEGA 2560 board is just like a brother of Arduino UNO board. It is way more powerful than Arduino UNO and also twice as long from it. This board is the successor of Arduino MEGA. It can be named as ATMega2560. It can have more memory space as compared to other boards of Arduino

(c) A4988 Motor Driver: The A4988 is a micro-striding driver for governing the stepper motors, it is incorporated with the interpreter (translator) for the tranquil process. By this controller stepper motor can control by 2 pinouts, one pin is to regulate the direction of motor revolutions and other is for steps regulation of motor. It works on 3 to 5.5V and it consumes per phase two amperes current in presence of the proper cooling environment.

(d) Stepper Motors: A stepper motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. The stepper motor is known by its property to convert a train of input pulses (typically square wave pulses) into a precisely defined increment in the shaft position. Each pulse moves the shaft through a fixed angle.

2.2 Schematic/Circuit Diagram

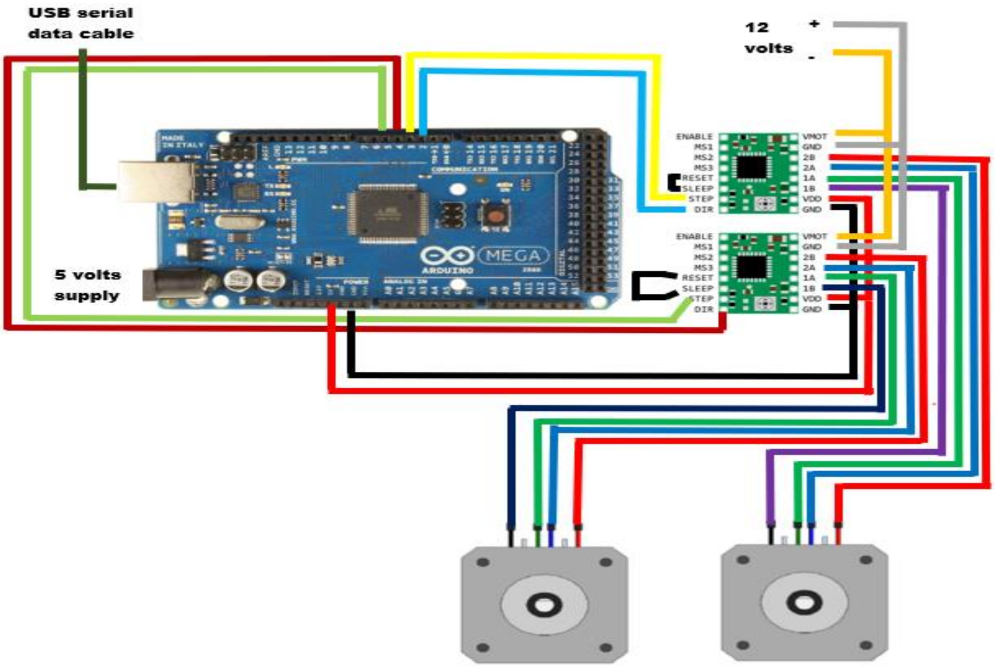

Fig. 2: Schematic

The above given circuit is tested for the final model. The Arduino controller board or the Arduino MEGA-2560 works with 5v input and the stepper motors drivers-A4988 run on 12 volts. However, the stepper controller run on 5 volts generated from the Arduino controller.

2.3 3D Printer Positioner Parts

The parts printed from FABX-PRO 3D printer with a fill density of 100% to obtain the toughest parts. However, the approach used for the printing remains the same i.e. FDM-Fused Deposition Method.

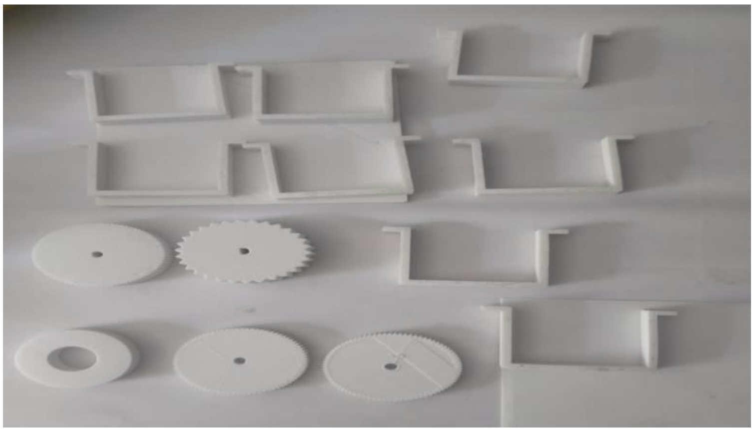

Fig. 3: 3D Printed Parts

2.4 Final LabVIEW Application

Final LabVIEW application ca be built from build specification in the environment settings itself from the tools option and this can be done only when the successful debugging has happened with any errors in the final output. After performing the build specification, you only view the front panel and cannot modify the logic responsible behind the application to run, unless you have all the necessary dependencies required to do so. However, you rename your application.exe file as per your requirement.

Fig. 4: Front Panel

The above Figure 4 is the final front panel after performing build specification operation. In that front you have all the configuration and stepper setting so that you have all the control over the positioner and make sure you transmit and receive from the desired direction. The LabVIEW code for both motors i.e. elevation motor and azimuthal motor is almost the same except for the different case labels that they have. Both motors can go both in clockwise and anti-clockwise directions for the specified number of steps or angle the operator provides through the front panel and the stepping precision of 0.9 degrees per step is obtained.

2.5 Final Model

The final model is basically a prototype design of the rotator we have tried to make and it is not yet ready to take any load for testing but hopefully it is capable of raking a load of up to 1 kilogram.

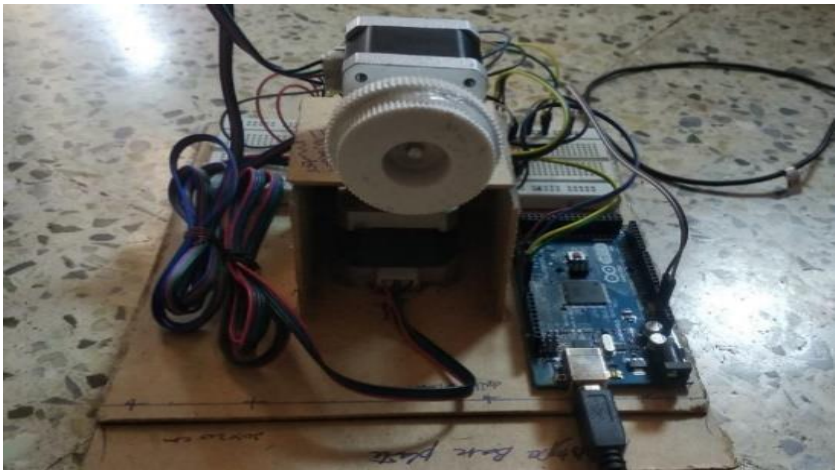

Fig. 5: Final Model

3. CONCLUSION

Rotation precision of up to 0.9 degrees is obtained for the rotator with an easy to use user interface which allows you to perform an operation whenever required and keep the rotator in standby mode to avoid unnecessary power consumption. However, the configuration steps may be many but the control over the rotator is worth following the steps and there a strong signal can be now obtained without any noise signals and in the same manner signal can be transmitted in a desired direction without the fear of being transmitted in unintended direction.

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5. REFERENCES

[1] NurulHazlinaNoordin, Addie Irawan, ZulkefleeKhalidin, A proposal of antenna positioner implementation on a moving vehicle for Geosynchronous Satellite system RESEARCH GATE.
[2] Joseph Timothy Foley1, Vladimir Omelianov1, Slawomir Koziel1, Adrian Bekasiewicz1, Low-cost Antenna Positioning System Designed with Axiomatic Design, MATEC Web of Conferences 127, 01015 (2017) ,ICAD 2017.
[3] Balanis, C. A. (2005). Antenna Theory: Analysis and Design, 3rd ed., Hoboken, NJ: John wiley and Sons.
[4] Waterhouse, R. (Ed.), (2007). Printed Antennas for Wireless Communications, Hoboken, NJ: John wiley and Sons.
[5] Dana Goldberg, "History of 3D Printing: It's Older Than You Are", April 2014 REDSHIFT by AUTODESK.
[6] A. Atala et al., "Tissue-engineered autologous bladders for patients needing cystoplasty," The Lancet, 367:1241-46, 2006.
[7] Kate Yandell, "Organs on Demand", Aug 31, 2013, The Scientist - Exploring Life, Inspiring Innovation.
[8] Athanasios Anastasiou, CharalambosTsirmpas, Alexandros Rompas, Kostas Giokas, Dimitris Koutsouris, "3D Printing: Basic concepts Mathematics and Technologies" , IEEE, pp 1-4, 201.
[9] Woern, Aubrey; Byard, Dennis; Oakley, Robert; Fiedler, Matthew; Snabes, Samantha (12 August 2018).
[10] "Fused Particle Fabrication 3-D Printing: Recycled Materials' Optimization and Mechanical Properties"."3D Printing: Challenges and Opportunities for International Relations". Council on Foreign Relations. 23 October 2013. Archived from the original on 28 October 2013.
[11] Chua, K. Leong, K. Lim, C. (2003). 'Rapid Prototyping: Principles and Applications' (2nd edition). World Scientific Publishing Company Singapore, 2003, P124.
[12] Gershenfeld, N. (2005), 'The Coming Revolution on Your Desktop: From Personal Computers to Personal Fabricators', Basic Books, New York, NY, April.
[13] Keith Ayotte, Hudson, NH (US); Paul Lagasse, Derry, NH (US); David Martin, Londonderry, NH (US); Anthony Sorrentino, Fitchburg, MA (US): Spencer Webb, Windham, NH (US); Mark Wheeler, Devens, MA (US); George Davison, Nashua, NH (US), COMPACT PORTABLE ANTENNA POSITIONER SYSTEMAND METHOD, United States Patent, Jul. 22, 2014

