Laser Display Setup Responsive to Audio Based Input

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Abstract— In this paper, we'll influence the Arduino to construct hardware that can yield and produce stimulating laser designs from auditory and music signals. Python will be doing more of the substantial work. Along with supervising serial port communications, it will be performing certain calculations basing itself on real-time audio data and implement those figures to adjust the motors in a laser show hardware rig. We use Fast Fourier Transform Technique for the conversion from audio signals to frequency. In order to govern the motors using Python and Arduino programming, we will be using python's numpy library to retrieve the Fast Fourier Transform of all the inputted audio figures. Our final end product would only start making sense when the laser and the twin motors would be arranged in an alignment that promotes projection of interesting and attractive patterns on the screen. The project also keeps in mind the voltage intricacies while operating the motors through the Arduino board.

Keywords—Laser, Fast Fourier Transform, pyaudio, Arduino, motors, numpy.

I. INTRODUCTION

In order to glorify these resolutions, we can think of any laser as some concentrated stream of light which will remain focused at a single small point, even when estimated over a huge space. The same focus is conceivable because the stream of light is prearranged so that its impressions travel in a single course only and remain in phase with all of the others. For the current project undertaking, we will practice a reasonable, easily accessible laser indicator to generate a laser design that produces alterations in sync to any kind of audio whether speech, music, etc. (or some other audio signal). We will be building hardware which will be creating stimulating configurations by means of the laser cursor and two spinning mirrors stuck to the motors. We will be incorporating the Arduino chip in order to establish the course and revolving speed of the toy dc motors that we will be controlling with the Python Programming language through serial communication. The written Python code would be reading music device input, analyzing it, and then converting the same into a motor velocity and direction figures to regulate the dual motors. We will also be learning about how we can allocate the speeds and directions of the required dual toy dc motors to synchronize with the obtained unlimited outlines and shapes of the inputted audio signal music.

Rest of the paper is organized as follows, Section I contains the introduction of how laser can utilize the power of simple motors and an Arduino board to generate something worth observing, Section II contains the related work of the whole procedure to be adopted in a step by step manner, Section III contains some measures of what kind of alignment would create various laser projections, Section IV contains the architecture and essential steps of setting up the whole device including the motors and their power mechanism, section V explains the applications and the possible scenarios for implementation of the said device.

II. PROCEDURE

Throughout the project, we will be combining and utilizing our Arduino and Python Programming acquaintance and will be taking it to the next level.

Following is the complete procedure that we'll be following for our whole project:

- Creating stimulating configurations and eye-catching patterns with the help of a laser and two of our gyrating circular mirrors.

- Receiving frequency info from a number of signals by incorporating 'Fast Fourier Transform'.

- Calculating 'Fast Fourier Transform' by calling in practice the '*numpy*' package of python programming language.

- Understanding musical and speech info by incorporating one of python's much awaited and very popular '*pyaudio*' library.

- Putting up a complete serial port communication for a computer machine and one Arduino device.

- Lashing and powering the dual toy dc motors accompanying one Arduino device.

III. CREATING VARIED PROJECTIONS WITH THE HELP OF LASERS

In order to produce all the required laser configurations in the current project, we will be using a laser cursor and two circular mirrors stuck to the tubes of the two tiny toy dual motors. When we project one laser beam pointing towards the exterior of the circular flat mirror (named as A), the reproduction expected will keep on a one and only point, even when the twin-motors are supposed to be rotating. Since the hydroplane of replication of the laser is upright to the rotating alliance of the twin-motors, it looks like the circular mirror is not spinning at all in front of the naked eye. Henceforth, let's say that the mirror would remain stuck at some planar angle to the chute (named as B). Till the chute is under the influence of rotation, the probable point will in return be tracing the traces of an elliptical shape, and even if the twin-motors are rotating swift enough, the watcher would perceive the stirring dot point as one single constant shape.

Now, what would happen when we place the circular glasses in a manner that the dot imitated off circular mirror A would be anticipated onto the surface of the circular mirror B? Henceforth, if the motor A and motor B would rotate, the design fashioned by the reproduced socket will turn out to be an amalgamation of the two gyratory activities of the motors A and the motor B, constructing fascinating designs.

The rigorous designs created would entirely be subject to the speeds and directions of revolution of the two toy twin-motors, but those will also be quite appealingly analogous to the hypotrochoid curves which are manufactured by a toy Spirograph.

A. Controlling the Motors

We will now be incorporating the Arduino chip device so as to regulate the speeds and directions of our dual twin-motors. The given format would require a lot of maintenance to ensure that it could take the moderately high energy of the toy dc twin-motors, as the Arduino device chip could only handle as much current so that it does not get completely devastated before a total voltage breakdown caused due to the overheat and overpressure. We could safeguard the Arduino device chipboard, reduce to bare bones the scheme, and decrease expansion time by exhausting the red-colored marginal breakout board. We will now be using this same breakout electronic board in order to regulate the speeds and directions of the two toy dc twin-motors at the same time from an Arduino device chipboard.

There is a nicely pre-soldered backside of the red-colored breakout circuit board device. The A and B that are named in the pins actually signify the two different toy dc twin-motors. The IN pin would regulate the track of the twin-motors, the pin number 1 and pin number 2 would be responsible to a typical command to the twin-motors, and the PWM pin would be responsible to regulate the motor speeds and directions. When we'll write to the same pins, we would be able to regulate the directions as well as speeds of spin for every motor. And this is what we exactly are needing for our laser display project.

B. The concept of Fast Fourier Transform

Since here our one and only goal and motivation of the project is to regulate the motor velocities on the basis of an audio music or speech input, therefore we will want to be capable of analyzing the frequencies of the input. We very well know that the tenors and tunes coming out of some string musical instrument are a combination of numerous regularities and overtones. Factually, any sound in the world could be easily disintegrated into its fundamental incidences if we use Fast Fourier transforms. Whenever the Fast Fourier transforms are smeared to digital motions, the outcome is mostly named the discrete Fourier transform (DFT) since digital indications are well covered of numerous discrete models.

Here to cope up with the current project, we will be using Python Programming Language in order to incorporate an FFT procedure so as to calculate the DFT.

In order to clarify the intricate meaning of FFT, we offer an extremely modest specimen of an FFT. We would display a signal that syndicates just only two sine impressions, along with the analogous FFT underneath it. The wave at the highest could be easily articulated by the subsequent equation that amounts the two so obtained waves.

C. Apparatus Required

- A tiny battery-powered laser cursor-pointer.

- Twin DC toy 6V powered motors exactly the ones that can be easily incorporated in a tiny children's toy

- Twin tiny circular mirrors about 1.5 inches or less in their width

- A 1A Motor Drive Dual with the make of any company

- A board of Arduino/Uno device chip or any other alike boards of the same make

- Jump wires so as to establish connections between all the chips (multiple wires of male-male, male-female, female-female types will serve the purpose)

- A battery pack that can fit 4 batteries of 1.5V in it.

- A raising platform that can act as a base for the twin-motors as well as the laser cursor-pointer in order to allow enough space to the motors to move freely.

- A square base sheet of wood or any rigid material like hardened polystyrene with good width and length and not that much of space to spill the hardware.

- Some quick fix glue

- Solder-iron rod

IV. BUILDING THE LASER EXHIBITION DEVICE

The principal instruction of transaction would be to affix the circular rotatory twin-mirrors onto the twin motors. The given mirror will have to be fixed at a certain angle of inclination with the motor tube. In order to fasten the circular mirrors, we will need to position the mirror face down upon a somewhat level exterior and place a droplet of warm quick-glue right in the midpoint.

We will now very cautiously dint the motor tube in the warm glue, positioning that upright to the circular glass till the glue strengthens. In order to experiment with it, we will be fitting the circular mirror using our hands while simultaneously outstanding the laser cursor at the same. We would apparently discover the image of the laser point moving in an elliptical path whenever estimated on a level exterior. We will follow the same procedure and instruction set or algorithm for the secondary circular mirror as well.

The auditory input, or sign, would be considered to be in the mentioned time sphere since the largeness statistics vary with respect to time. The FFT would always remain in the regularity purview. To calculate an FFT, we would humbly require a huge or bigger set of models. The superior of the numeral of tasters is a bit subjective, but a minor trial size might not be giving us a very nice portrait of the indicator's frequency data and may also sometimes mean a much higher calculative bulk as we would be requiring computing more of the Fast Fourier Transforms per instance.

A. *Alignment of the Circular Mirrors*

Furthermore, we will be aligning the laser cursor point withstanding the circular twin-mirrors in order to make sure that the laser point/dot is reflected from one circular mirror to another. In order to ensure that the echoed laser beam from one circular mirror A stayed inside the perimeter of circular mirror B for the second circular mirror in the entire series of gyration. (This procedure will involve some error and trial) Now to experiment with this setup, automatically we would be rotating the first circular mirror. Also, we have to be sure to place circular mirror B in a manner such that the beam

reproduced from that exterior would be falling on a level shallow (just like a boundary fence) for the complete series of a spin of both the circular glasses.

The moment we are satisfied with whatever be the alignment of the circular mirrors, we can easily apply lots of hot-hot glue onto the laser cursor and the two dc toy twin-motors coming with the affixed glasses on the three indistinguishable chunks to elevate them up so that they can get the ability to be aligned properly as well as rotate or gyrate freely. Further, we can put these chunks of raised platforms onto the mount baseboard, and whenever we are content with this plan, we can easily spot the locations of every one of them by locating this edge using a pen. We will then have to warmly glue the chunks on the baseboard.

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B. *Empowering the Toy Motors*

Just in case our toy motors don't come along with cables fixed to their respective stations (since most of them do not), we'll need to use the soldering iron rod to connect the wires to both the terminals, by completely having a surety to vacate enough cable (for instance 25 centimetres) so that we could easily fix the twin-motors to the dc toy motor carter board. These motors will be empowered by few batteries in a 4 AA battery pack that we could warmly glue to the posterior of the baseboard.

From here onwards we will be testing our so patiently assembled hardware by rotating both circular tiny mirrors using our hands as the laser is shone onto them. In case we spin these loose sufficient, we would be able to observe some remarkable designs developing in a preview of what is about to show up.

C. *Implementing the Execution*

In order to examine the given major plan, we'll be assembling this so-called hardware Arduino programming chip device, connecting the Arduino programming device chipboard onto the mainframe, and thereby uploading this motor driving sketch program into the programming board Arduino chip. We will also have to ensure that the cordless carton is linked and that our laser indicator is switch completely on and is properly projected on a level surface like a wall-like screen which is completely real. We ourselves recommended and tested the laser exhibition portion primary by executing the following code. (We also cannot completely overlook to transform the serial communication porting sentence so as to contest with our mainframe!) This

examination scores both motors by numerous mixtures of hustles and course. We can easily perceive dissimilar laser designs predictable onto our wall-like screen.

Now if we want to halt the code and the motors, we would be required to press the keys control and alphabet 'C'. Just when this exam succeeds, we would fully equip and prepared to passage on to the actual demonstration. Now we can easily begin playing our preferred melody on our computing machine mainframe and then execute the same code and the program as required and desired. (Now here too, we would be required to observe that the serial porting communication sentence!)

V.   APPLICATIONS

- Laser and music shows.
- Musical fountains.
- Entertainment industry such as carnivals and fates.

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