

LASER HARP

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ABSTRACT

Modern time calls for innovation and thinking outside the box. As the name suggests, here we have LASERS replacing the conventional strings in a harp. Instead of plucking the strings one just needs to place hands in the path of beams. Different lasers are used for different notes and every laser creates multiple pitches depending upon the position of the hand. Various tones could be created by hitting proper chords as every point is intercepted differently. Here we have a perfectly calibrated harp. The lasers are just for visually guiding the user and act as visual strings. The main purpose of strings is served by photo diodes and proximity sensors. Different set of diodes and sensors act as individual strings which are calibrated to produce different notes. On single set the proximity sensor act as frets producing unique pitch at unique location. AT mega is programmed to give desired output. Tuning is adjusted in the program itself. For this project we are using AT mega 16, photo diodes, laser transmitters, LCD.

Keywords: ATMEGA16, Lasers, Photo Diodes, LCD Display, Speaker with Amplifier, Music Instrument

I. INTRODUCTION

The Laser Harp is an electronic harp using laser beams instead of conventional strings. The user will be able to play notes by breaking the beams with his/her hands. The Laser Harp is a new musical instrument where notes are selected and played by breaking the beams of 7 separate lasers, representing each of the major and minor notes in a musical octave. The harp itself is rectangular in shape, approximately 3 feet wide and 4 feet tall, with 7 parallel 532nm (red) laser beams pointing vertically spaced evenly across it, each pointed towards a phototransistor. When the user breaks a beam (by placing their hand in it), the corresponding note is played out through external speakers. The harp also determines the vertical height of the user's hand along the harp, and the tone of the played note is modulated accordingly. Each phototransistor circuit is fed into a microprocessor, which detects which string has been broken, and thus which note must be played.

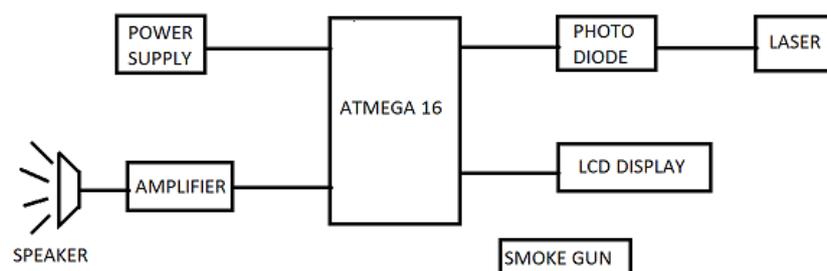


Fig1. Block Diagram

II. INITIAL USAGE SCENARIO

The Laser Harp is meant to be commercialized as a musical toy. The design of the harp will be as simple as possible, thus will come with little instructions. We envisioned one ON/OFF button and 3 teacher toggle buttons, one for each preset song. The Laser Harp would have an automatic power-off function. To operate the unit, the user would break the beams with any object, most likely their fingers; as soon as the beam is broken, the appropriate note will be played, through a built-in speaker. A user could use the instrument as an educational tool, taking advantage of the teaching mode feature in order to learn and play simple songs. By pressing a button, the teaching mode would be activated. While in teaching mode, the Laser Harp would teach a preset melody by turning off lasers, one note at a time, allowing the child to see what note to play and in what order.

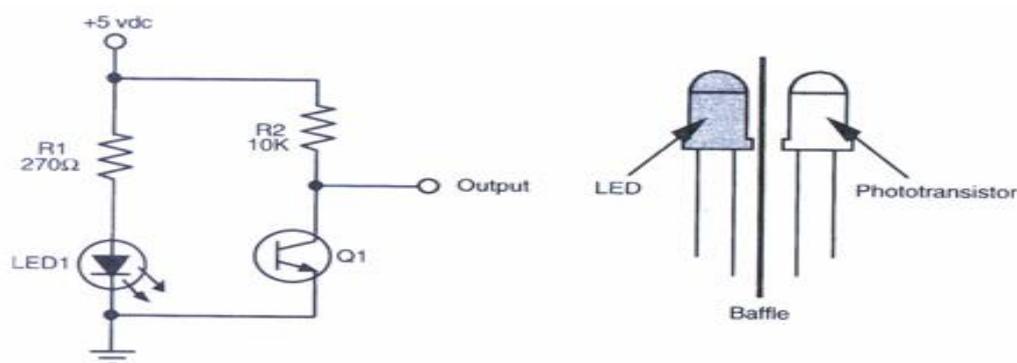
III. DEVELOPMENT STAGES & PROCESS

The complete development of this system can be divided into the following stages:

- Problem definition stage;
- Designing block diagram;
- Implementing circuits and components;
- Developing algorithm for software;
- Writing actual code for Microcontroller;
- Compiling the code;
- Burning the hex file into microcontroller with programmer
- Testing and Running.

IV. OVERVIEW OF THE BUILDING BLOCKS.

4.1 Photo Transistor



The basic design of the infrared proximity sensor.

Fig2. Photo Transistor and Corresponding Circuit

A Photodiode is a p-n junction or p-i-n structure. When an infrared photon of sufficient energy strikes the diode, it excites an electron thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region, producing a photocurrent. Photodiodes can be used under either zero bias (*photovoltaic mode*) or reverse bias (*photoconductive mode*). Reverse bias induces only little current (known as saturation or back current) along its direction. But a more important effect of reverse bias is

widening of the depletion layer (therefore expanding the reaction volume) and strengthening the photocurrent when infrared falls on it.

4.2 Laser

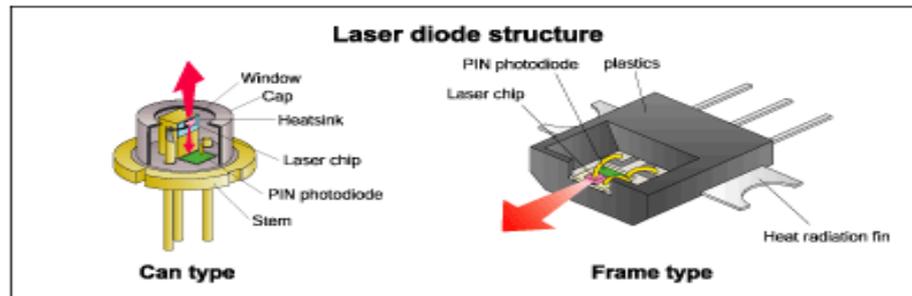


Fig3. Laser diode

A laser (light amplification by stimulated emission of radiation) is a device which uses a quantum mechanical effect, stimulated emission, to generate a coherent beam of light from a lasing medium of controlled purity, size, and shape. The output of a laser may be a continuous, constant-amplitude output (known as *CW* or *continuous wave*), or pulsed, by using the techniques of Q-switching, model locking, or gain-switching. In pulsed operation, much higher peak powers can be achieved. A laser medium can also function as an optical amplifier when *seeded* with light from another source. The amplified signal can be very similar to the input signal in terms of wavelength, phase, and polarisation; this is particularly important in optical communications. The verb "to lase" means to give off coherent light or possibly to cut or otherwise treat with coherent light, and is a back-formation of the term laser.

4.3 Atmega 16

Now the key component is the ATMEGA16 AVR microcontroller. The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

4.4 LM7805 Series Voltage Regulators

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. It may use an electromechanical mechanism, or passive or active electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. With the exception of shunt regulators, all voltage regulators operate by comparing the actual output voltage to some internal fixed reference voltage. Any difference is amplified and used to control the regulation element. This forms a negative feedback servo control loop. If the output voltage is too low, the regulation element is commanded to produce a higher voltage. If the output voltage is too high, the regulation element is commanded to produce a lower voltage. In this way, the output voltage is held roughly constant.

V. POWER SUPPLY DESIGN

Power supply is the first and the most important part of our project. For our project we require +5V regulated power supply with maximum current rating 500Ma.

Following basic building blocks are required to generate regulated power supply.

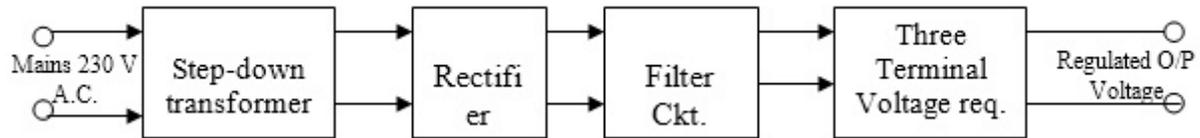


Fig 4. Power Supply

5.1 Step Down Transformer

Step down transformer is the first part of regulated power supply. To step down the mains 230V A.C. we require step down transformer. Following are the main characteristic of electronic transformer.

- 1) Power transformers are usually designed to operate from source of low impedance at a single freq.
- 2) It is required to construct with sufficient insulation of necessary dielectric strength.
- 3) Transformer ratings are expressed in volt-amp. The volt-amp of each secondary winding or windings are added for the total secondary VA. To this are added the load losses.
- 4) Temperature rise of a transformer is decided on two well-known factors i.e. losses on transformer and heat dissipating or cooling facility provided unit.

5.2 Rectifier Unit

Rectifier unit is a circuit which converts A.C. into pulsating D.C. Generally semi-conducting diode is used as rectifying element due to its property of conducting current in one direction only. Generally there are two types of rectifier.

- 1) Half wave rectifier
- 2) Full wave rectifier.

In half wave rectifier only half cycle of mains A.C. is rectified so its efficiency is very poor. So we use full wave bridge type rectifier, in which four diodes are used. In each half cycle, two diodes conduct at a time and we get maximum efficiency at o/p.

Following are the main advantages and disadvantages of a full-wave bridge type rectifier circuit.

Advantages:

- 1) The need of center tapped transformer is eliminated.
- 2) The o/p is twice that of center tap circuit for the same secondary voltage.
- 3) The PIV rating of diode is half of the center tap circuit.

Disadvantages:

- 1) It requires four diodes.
- 2) As during each half cycle of A.C. input, two diodes are conducting therefore voltage drop in internal resistance of rectifying unit will be twice as compared to center tap circuit.

5.3 Filter Circuit

Generally a rectifier is required to produce pure D.C. supply for using at various places in the electronic circuit. However, the o/p of rectifier has pulsating character i.e. if such a D.C. is applied to electronic circuit it will produce a hum i.e. it will contain A.C. and D.C. components. The A.C. components are undesirable and must be kept away from the load. To do so a filter circuit is used which removes (or filters out) the A.C. components reaching the load. Obviously a filter circuit is installed between rectifier and voltage regulator. In our project we use capacitor filter because of its low cost, small size and little weight and good characteristic. Capacitors are connected in parallel to the rectifier o/p because it passes A.C. but does not pass D.C. at all.

VI. SOFTWARE DEVELOPMENT

The model used is Classic Life Cycle Model

- The Project team is meeting once a week to discuss the progress made by each member and to share the relevant information and be documents that have been prepared. The number of meetings may increase during the final semester as the team members will have more time.
- There are reviews being conducted once a week during the team meetings. A complete technical review will be conducted at the end of the Design Phase. There will be reviews conducted at the completion of every testing phase.
- The major milestones to be achieved are as follows:
 1. Results of research of existing system and discussions with the Project leader.
 2. Results of interview with experts and team meetings to finalize the requirements of the software.
 3. Results of the Design Phase, which include a number of modeling diagrams, like the use cases, class diagrams, etc.
 4. Results of the first coding phase will be an initial code that will be then tested.

Based on the results of the testing, the code will be reviewed in the second coding phase.

VII. RESULT



Fig5. Laser Harp

VIII. CONCLUSION

In this project, the design and implementation of a new kind of electronic musical instrument has been explored. From the results, it is evident that this kind of device is both practical and relatively inexpensive to construct and operate. We successfully implemented the requirements we set out to achieve. The fundamentals of this system are formed, but the overall design, precision and effectiveness can be improved. With further adaptations and improved methods, the possibilities of this device are endless. It opens up a whole new area to the electronic musical industry.

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