**AIR DEFENSE GUN**

**INTRODUCTION**

As the semi-conductor technology is experiencing rapid growth, human life gets complicated without “embedded system”. Nowadays these new technologies are introduced in the equipments engaged in the battlefield to improve the safety of soldiers and also to ensure combat effectiveness. Our scope is to develop a mechanism to automatically control the movement of the air defense gun mounted on the tank. To understand our project better, let’s consider our indigenous tank ‘ARJUN’ designed by CVRDE, DRDO. It consists of hull and turret. The latter is provided with three hatches .There are four crew members namely loader, gunner, driver and commander .The tank is equipped with three guns, namely main gun, machine gun and air defense gun. Main gun uses FSAPDS and HESH as ammunition, the coaxial 7.62mm PKT machine gun and a 12.7mm air defense machine gun. A 5.45mm AKS-74 assault rifle is carried on a storage rack.

Air defense gun is mounted on the loader’s hatch in the turret of the tank and is controlled by the loader .It is primarily used to attack low flying armored vehicles. Presently the gunner has to expose himself to track the enemy vehicle and attack the target and so he becomes vulnerable to external foes, added to it he has to manually adjust the desired elevation and depression of the air defense gun.

Our project focuses on the safety of the gunner by employing embedded systems to position the air defense gun without having the gunner exposed.

**SCOPE**

The scope of the project is to create a conceptual model enabling power operated movement of air defense gun in place of the existing manual operation.

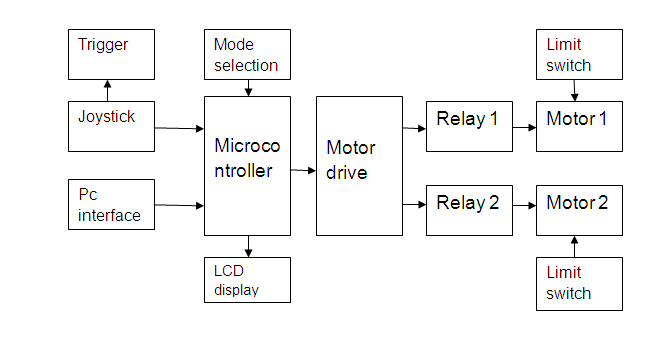
**PRESENT STATUS ON MBT ARJUN**

Presently the air defense gun is maneuvered manually both in azimuth and vertical planes. This entails operation of the air defense gun by the loader in the hatch opened condition, exposing the loader to the attack by the enemy. Also this manual operation will be a tiring activity.

**BASIC REQUIREMENTS**

The system should enable sighting of the target through a sight, aiming the target in hatch closed condition by slewing and elevating/ depressing anti-aircraft gun The system should enable the rotation of loader’s hatch in azimuth plane both in anti-clockwise and clockwise direction through 360 degree. The movement of air defense gun in the vertical plane is from -10 degree to +70 degree. The system also requires automatic stopping of gun movement if it attains the extreme positions in the vertical plane.

**BASIC BLOCK DIAGRAM OF AUTOMATIC LAYING OF AIR DEFENSE GUN**



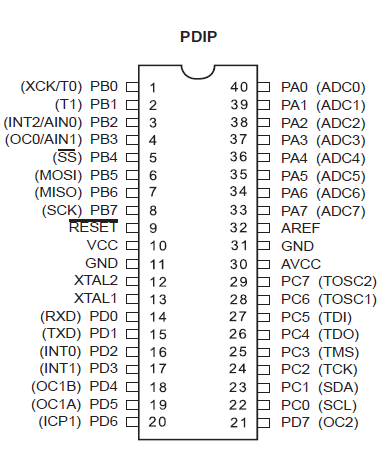
**TECHNICAL DESCRIPTION**

**JOYSTICK**



* Joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer. A popular variation of the joystick used on modern video game consoles is the analog stick.
* The joystick has been the principal flight control in the cockpit of many aircraft, particularly military fast jets, where center stick or side-stick location may be employed.
* Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles, wheelchairs, surveillance cameras and zero turning radius lawn mowers. Miniature finger-operated joysticks have been adopted as input devices for smaller electronic equipment such as mobile phones.

**MICROCONTROLLER ATMEGA32**

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The AVR core combines a rich instruction set with 32 general purpose working registers. All the32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers .The ATmega32 provides the following features: 32K bytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 1024 bytes EEPROM, 2K byte SRAM, 32general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundaryscan ,On-chip Debugging support and programming, three flexible Timer/Counters with compare models, Internal and External Interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain (TQFP package only), a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the USART, Two-wire interface, A/D Converter, SRAM, Timer/Counters ,SPI port, and interrupt system to continue functioning. The Power-down mode saves the register

contents but freezes the Oscillator, disabling all other chip functions until the next External Interrupter Hardware Reset. In Power-save mode, the Asynchronous Timer continues to run ,allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer , to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run.

The device is manufactured using Atmel’s high density nonvolatile memory technology. The On chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip ,the Atmel ATmega32 is a powerful microcontroller that provides a highly-flexible and cost-effective solution to many embedded control applications .The ATmega32 AVR is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger/simulators, in-circuit emulators ,and evaluation kits.

## LCD DISPLAY

A liquid crystal display (LCD) is a thin, flat [electronic visual display](http://en.wikipedia.org/wiki/Electronic_visual_display) that uses the light modulating properties of [liquid crystals](http://en.wikipedia.org/wiki/Liquid_Crystals) (LCs). LCs do not emit light directly.

**SPECIFICATION**

Important factors to consider when evaluating an LCD monitor:

* [Resolution](http://en.wikipedia.org/wiki/Display_resolution): The horizontal and vertical screen size expressed in pixels (e.g., 1024×768). Unlike [CRT monitors](http://en.wikipedia.org/wiki/CRT_monitors), LCD monitors have a native-supported resolution for best display effect.
* [Dot pitch](http://en.wikipedia.org/wiki/Dot_pitch): The distance between the centers of two adjacent pixels. The smaller the dot pitch size, the less granularity is present, resulting in a sharper image. Dot pitch may be the same both vertically and horizontally, or different (less common).
* Viewable size: The size of an LCD panel measured on the diagonal (more specifically known as active display area).
* [Response time](http://en.wikipedia.org/wiki/LCD_response_time): The minimum time necessary to change a pixel's colour or brightness. Response time is also divided into rise and fall time. For LCD monitors, this is measured in btb (black to black) or gtg (gray to gray). These different types of measurements make comparison difficult.
* [Input lag](http://en.wikipedia.org/wiki/Input_lag) - a delay between the moment monitor receives the image over display link and the moment the image is displayed. Input lag is caused by internal digital processing such as image scaling, noise reduction and details enhancement, as well as advanced techniques like frame interpolation. Input lag can measure as high as 3-4 frames (in excess of 67 ms for a 60p/60i signal). Some monitors and TV sets feature a special "gaming mode" which disables most internal processing and sets the display to its native resolution.
* [Refresh rate](http://en.wikipedia.org/wiki/Refresh_rate): The number of times per second in which the monitor draws the data it is being given. Since activated LCD pixels do not flash on/off between frames, LCD monitors exhibit no refresh-induced flicker, no matter how low the refresh rate.[[3]](http://en.wikipedia.org/wiki/Liquid_crystal_display#cite_note-2) High-end LCD televisions now feature up to 240 Hz refresh rate, which allows advanced digital processing to insert additional interpolated frames to smooth up motion, especially with lower-frame rate 24p material like the [Blu-ray disc](http://en.wikipedia.org/wiki/Blu-ray_disc). However, such high refresh rates may not be supported by pixel response times, and additional processing can introduce considerable input lag.
* [Matrix type](http://en.wikipedia.org/wiki/Liquid_crystal_display#Passive-matrix_and_active-matrix_addressed_LCDs): Active [TFT](http://en.wikipedia.org/wiki/Thin_film_transistor) or Passive.
* [Viewing angle](http://en.wikipedia.org/wiki/Viewing_angle): (coll., more specifically known as [viewing direction](http://en.wikipedia.org/wiki/Viewing_cone)).
* Colour support: How many types of colours are supported (coll., more specifically known as colour [gamut](http://en.wikipedia.org/wiki/Gamut)).
* [Brightness](http://en.wikipedia.org/wiki/Brightness): The amount of light emitted from the display (coll., more specifically known as [luminance](http://en.wikipedia.org/wiki/Luminance)).
* [Contrast ratio](http://en.wikipedia.org/wiki/Contrast_ratio): The ratio of the intensity of the brightest bright to the darkest dark.
* [Aspect ratio](http://en.wikipedia.org/wiki/Aspect_ratio): The ratio of the width to the height (for example, 4:3, 5:4, 16:9 or 16:10).
* Input ports (e.g., [DVI](http://en.wikipedia.org/wiki/Digital_Visual_Interface), [VGA](http://en.wikipedia.org/wiki/Video_Graphics_Array), [LVDS](http://en.wikipedia.org/wiki/Low-voltage_differential_signaling), [DisplayPort](http://en.wikipedia.org/wiki/DisplayPort), or even [S-Video](http://en.wikipedia.org/wiki/S-Video) and [HDMI](http://en.wikipedia.org/wiki/High-Definition_Multimedia_Interface)).
* [Gamma correction](http://en.wikipedia.org/wiki/Gamma_correction)

**LIMIT SWITCH**

In [electronics](http://en.wikipedia.org/wiki/Electronics), a switch is an [electrical component](http://en.wikipedia.org/wiki/Electrical_component) that can break an [electrical circuit](http://en.wikipedia.org/wiki/Electrical_circuit), interrupting the [current](http://en.wikipedia.org/wiki/Electric_current) or diverting it from one conductor to another. The most familiar form of switch is a manually operated [electromechanical](http://en.wikipedia.org/wiki/Electromechanical) device with one or more sets of [electrical contacts](http://en.wikipedia.org/wiki/Electrical_contact). Each set of contacts can be in one of two states: either 'closed' meaning the contacts are touching and electricity can flow between them, or 'open', meaning the contacts are separated and non conducting.

A switch may be directly manipulated by a human as a control signal to a system, such as a computer keyboard button, or to control power flow in a circuit, such as a [light switch](http://en.wikipedia.org/wiki/Light_switch). Automatically-operated switches can be used to control the motions of machines, for example, to indicate that a garage door has reached its full open position or that a machine tool is in a position to accept another work piece. Switches may be operated by process variables such as pressure, temperature, flow, current, voltage, and force, acting as [sensors](http://en.wikipedia.org/wiki/Sensor) in a process and used to automatically control a system. For example, a [thermostat](http://en.wikipedia.org/wiki/Thermostat) is an automatically-operated switch used to control a heating process. A switch that is operated by another electrical circuit is called a [relay](http://en.wikipedia.org/wiki/Relay). Large switches may be remotely operated by a motor drive mechanism. Some switches are used to isolate electric power from a system, providing a visible point of isolation that can be pad-locked if necessary to prevent accidental operation of a machine during maintenance, or to prevent electric shock.

## DRIVING STEPPER MOTORS WITH THE L293D

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The L293D contains two H-bridges for driving small DC motors. It can also be used to drive stepper motors because stepper motors are, in fact, two (or more) coils being driven in a sequence, backwards and forwards. One L293D can, in theory, drive one bi-polar 2 phase stepper motor.

#### TRIGGER

#### A trigger is a [mechanism](http://en.wikipedia.org/wiki/Mechanism_(technology)) that actuates the firing sequence of [firearms](http://en.wikipedia.org/wiki/Firearm), or a [power tool](http://en.wikipedia.org/wiki/Power_tool). Triggers almost universally consist of [levers](http://en.wikipedia.org/wiki/Lever) or buttons actuated by the [index finger](http://en.wikipedia.org/wiki/Index_finger). Rare variations use the thumb to actuate the trigger.

Firearms use triggers to initiate the firing of a cartridge in the firing chamber of the weapon. This is accomplished by actuating a striking device through a combination of spring and [kinetic energy](http://en.wikipedia.org/wiki/Kinetic_energy) operating through a [firing pin](http://en.wikipedia.org/wiki/Firing_pin) to strike and ignite the primer.

**MODE SELECTION: BURST MODE**

In [automatic firearms](http://en.wikipedia.org/wiki/Automatic_firearm), burst mode or burst fire is a firing mode enabling the shooter to fire a predetermined number of [rounds](http://en.wikipedia.org/wiki/Cartridge_(firearms)), usually 2 or 3 rounds or 100+ on [anti-aircraft weapons](http://en.wikipedia.org/wiki/Anti-aircraft_weapons), with a single pull of the trigger. This firing mode is commonly used in [submachine guns](http://en.wikipedia.org/wiki/Submachine_gun), [assault rifles](http://en.wikipedia.org/wiki/Assault_rifle) and [carbines](http://en.wikipedia.org/wiki/Carbine) The burst mode is normally employed as an intermediate fire mode between [semi-automatic](http://en.wikipedia.org/wiki/Semi-automatic_firearm) and [fully-automatic](http://en.wikipedia.org/wiki/Automatic_firearm), although some firearms lack a "full auto" capability and use a burst mode instead. The number of rounds fired in a burst is almost universally determined by a [cam](http://en.wikipedia.org/wiki/Cam) mechanism that trips the trigger mechanism for each shot in the burst. Some designs will terminate the burst if the trigger is released before the burst is complete, while others will reset the cam position, so the next burst will fire a full number of rounds.

**ADDITIONAL FEATURES**

* PC interface with the circuit for future processes.
* Updating and displaying the number of bullets fired.
* Using image processing for targeting the gun with the hatch in closed position.
* Use of advanced motors for a better control of position.
* Use of real time cameras for tracking the movement of the air defence gun.

**PROPOSED ACTION PLAN**

On finalisation of the hardware the same will be procured for testing and assembly. Necessary software also to be generated for the mechanism to function