

Arduino Based Gesture Controlled Gun

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Abstract - This project is a system designed to control a military gun remotely using hand gestures. A soldier on the watch tower specifically can be replaced by smart gesture controlled gun. At the top of a watchtower, a gun will be mounted and its movements will be controlled from a remote control room using hand gestures detected by an accelerometer. Camera installed on-board the gun will give us the visuals on the monitor. Since the soldier is not operating the gun directly, security will be maintained even at heavy firing. Thus this project reduces death risk of soldier.

This data in terms of degrees is stored in a variable that is given to the two servo motors for horizontal and vertical motion of the gun. The trigger of the gun is operated by another servo which is controlled by a pushbutton.

The mechanical structure is designed in Solid Works 2012. The optimum height of gun mount was decided based on the total weight of the gun assembly and the base structure. Ribbon cables were used between the servo motors and Arduino.

1. INTRODUCTION

A 3-axis accelerometer detects acceleration in three planes i.e. roll, pitch and yaw. However in this project we use only two planes i.e. roll and pitch. The accelerometer sends this data over the Inter-Integrated Circuit (I2C) bus. The controller that we have used is the Arduino Uno R3 that also supports I2C bus. The Arduino calibrates the orientation data into corresponding number of degrees.

1.1 OBJECTIVE OF THE PROJECT

- To reduce the death risk of a soldier by remotely controlling the gun.
- To maintain security even at heavy firing from the enemy.
- For surveillance and reconnaissance.

2. BLOCK DIAGRAM

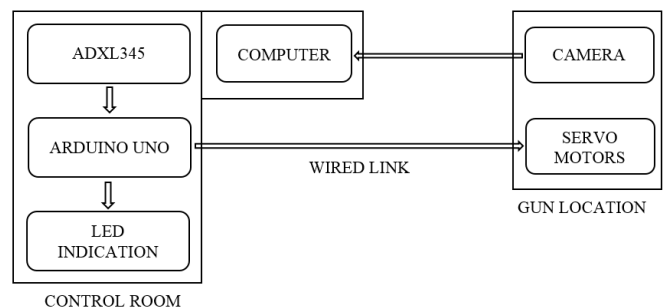


Fig -2: Block Diagram of Proposed System

There are two sections, first one is a control room or a bunker from where the gun will be controlled by the soldier using hand gestures. Second section is the gun base where the gun is mounted on the watch tower at remote areas.

The hand gestures of the soldier are detected by the accelerometer ADXL 345. The output of the ADXL345 is given to the microcontroller ATMEGA328PU which will convert this output to particular signals that are transmitted via I2C communication bus. These signals are given to the two servo motors for controlling the gun in horizontal and vertical

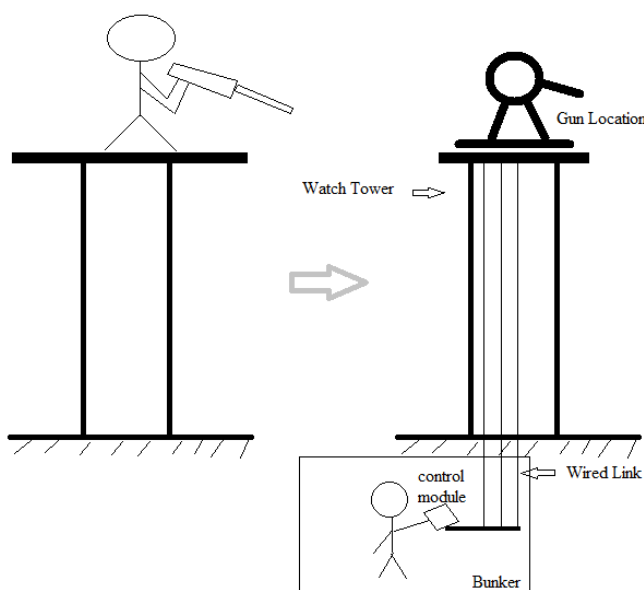


Fig -1: A gun mounted on watch tower

direction, i.e. one of the servo motor is used for vertical movement of the gun, and another for horizontal movement of the gun. The trigger motor which is used for the gun firing which is controlled by a pushbutton.

Webcam is used to give the visuals on the monitor. Connection of the webcam is through universal serial bus (USB). Webcam is mounted on the gun. Using these visuals the soldier can get to about all the movements of the enemy and can attack them easily. The crosshair on the monitor is approximately pointed towards the point at which the bullet will meet the target.

3. METHODOLOGY

Initially we had decided to use stepper motor for horizontal and vertical motion of the gun and servo motor for the trigger. But stepper motors were very slow and required separate drivers for their operation. They also increased complexity and cost of the project. So we decided to modify our design and used servo motors for motion control as well as for trigger control. This also reduced complexity of our project. We have used 3-axis accelerometer i.e. ADXL345 instead of ADXL335 because it has better stability and g-force range.

The program modules for servo motors were taken from Adafruits website and accelerometer modules from Sparkfun website. We have designed the mechanical structure in Solid Works 2012 software.



Fig -3: Project Prototype

4. FLOW CHART

When the program starts, a power switch is monitored continuously to check whether the power switch is pressed. If power switch is pressed then power state is altered. If power state is 0, then it is made equal to 1 and vice versa. Once power state is high, ADXL input is read over I2C by the Arduino.

The Arduino performs calibration and mapping on the received data from ADXL. Then Arduino sends commands to the servo motors and LED indications. The Arduino also sends operation data to serial window.

This whole program repeats for infinite number of times.

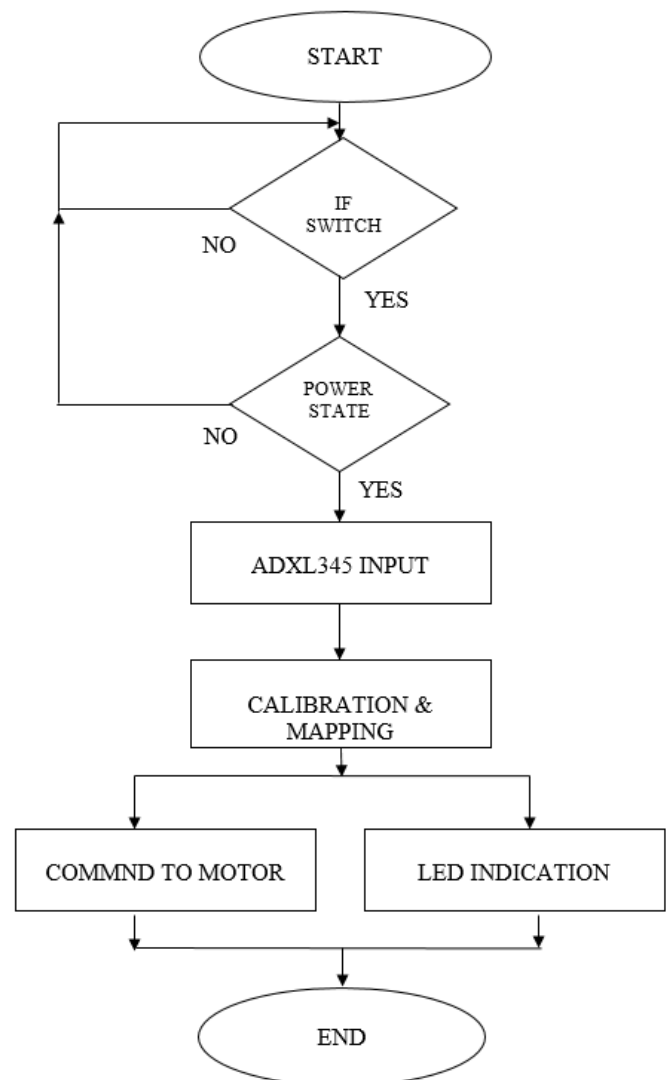


Chart -1: Flow chart of the program

5. COMPONENT INTERFACING

5.1 SERVO MOTOR INTERFACING

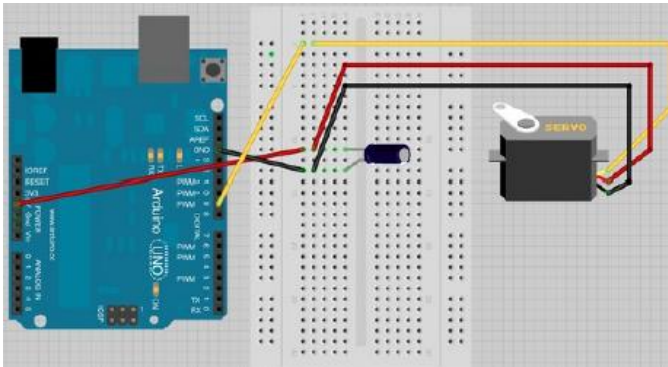


Fig -4: Servo Motor Interfacing

The servo motor has three pins. The color of the pins varies between servo motors, the red lead is always 5V and GND will either be black or brown. The other pin is the control pin and this is usually orange or yellow. This control pin is connected to digital pin 9. The servo motor is terminated in a header into which we can push jumper wires, to it link to the Arduino. The servo motor draws lot of power during start up, and this sudden high demand of current can be enough to drop the voltage on the Arduino board. We have eliminated this by adding a high value capacitor of value greater than 470uF between GND and 5V on the breadboard. The capacitor acts as a storage element of charge for the motor, so that when it starts, it takes charge from the capacitor as well as the Arduino supply.

5.2 ADXL345 ACCELEROMETER INTERFACING

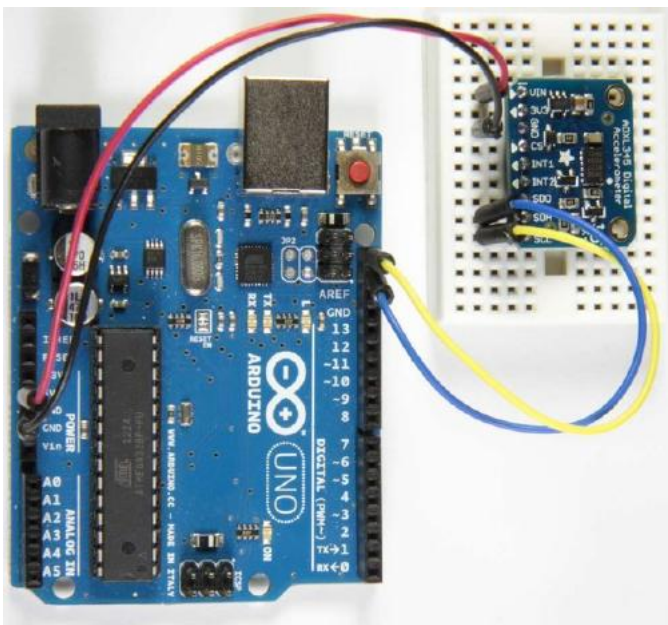


Fig -5: ADXL345 Interfacing

The ADXL345 accelerometer consists of a micro-machined structure which is fabricated on a single silicon wafer. This structure is suspended using a set of polysilicon springs which allow it to deflect smoothly in any direction when the sensor is subjected to acceleration in the X, Y and Z axis. This deflection causes a change in capacitance on each axis that is converted to an output voltage proportional to the acceleration on that axis.

The ADXL345 has a fixed I2C address of 0x53. It can use the same I2C bus with other I2C devices as long as each device has a different device addresses.

Following connections are required for I2C communication:

- GND->GND
- VIN->+5v
- SDA->SDA (Analog 4 on some Arduinos)
- SCL->SCL (Analog 5 on some Arduinos)

5.3 INTERFACING OF DIGITAL SWITCHES

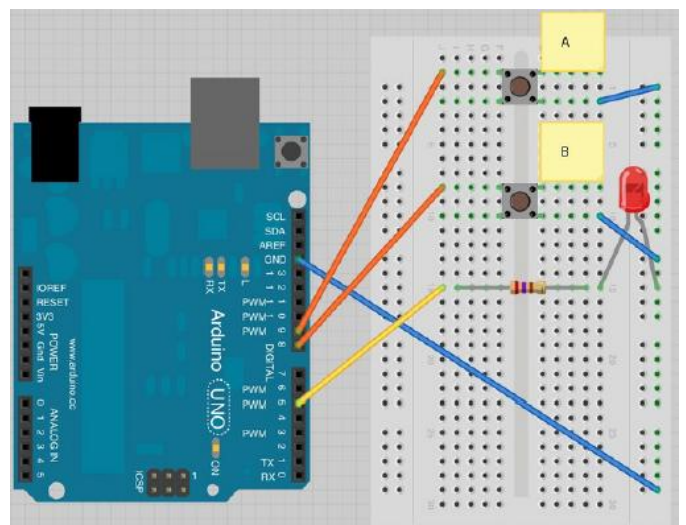


Fig -6: Digital Switch Interfacing

There are two switches used, one for triggering the gun and the second for active ON/OFF control. Each switch requires one digital pin of Arduino. These pins are used as input pins in INPUT_PULLUP mode which means that it should be pulled up to high. The default value for the input is high, unless it is pulled low by the action of pressing the switch.

When the trigger switch is pressed, the trigger LED glows and the servo motor for trigger turns by 60-90 degrees. When the trigger switch is released, the LED turns off and the servo comes back to original position. The active ON/OFF switch works in such a way that when switch is pressed once, all the gun controls are active. When the switch is pressed again, the deflection of the sensor has no effect on the movement of the gun and its trigger.

6. APPLICATIONS

- Can be used for reconnaissance or surveillance.
- Can be deployed along the borders and in remote areas.
- Can be deployed on the watchtowers of a modern jails.
- Gesture controlled guns can be deployed on warships replacing human counterparts directly involved in combat.

7. FUTURE SCOPE

- Image processing can be implemented to detect humans in the video stream.
- Thermal imaging can be used to get better visuals during night time.
- Wireless communication can be implemented to control the gun wirelessly.
- We can have complete data interchangeability to control the gun using other weapon systems.
- The gun can be made detachable in case if some part of the system gets damaged it can be used separately by the soldier.
- Dynamic armouring can be used to protect the gun from heavy firing.

8. CONCLUSIONS

In this project an effort has been taken to design a system that can control the direction of a gun which can be controlled remotely thus replacing human counterparts. The gun is controlled by hand gestures using an accelerometer. The program for each component i.e. for I2C communication from accelerometer, Arduino processing, Digital I/O, LED indicators and Servo motors is written in Arduino IDE 1.6.3. These program modules are obtained from support websites and are simulated individually and then integrated together to get the final output. From this we can conclude that a system can be designed to control a gun remotely to replace human counterparts.

REFERENCES

- [1] Massimo Banzi, "Getting started with Arduino", published by O'reilly in the 2015.
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BIOGRAPHIES



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