Control Mechanism for Gun using Virtual Reality Gear

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ABSTRACT
This project mainly concentrates on controlling the gun using a Virtual Reality (VR) gear. A soldier specifically on a watch tower can be replaced with this system. This system can be controlled from soldier present in remote control room by head movements. Camera installed on the gun streams the visuals in VR gear and also displays it on the monitor. Since the soldier is not operating the gun directly, security will be maintained even at heavy firing. Thus system reduces probability of death of a soldier.

Keywords
Virtual Reality; Remote control; Visuals stream; Security.

1. INTRODUCTION
The mobile present in VR gear has a custom developed mobile application which fetches Accelerometer and orientation sensor values of mobile and then sends these values through Bluetooth to the system. The system consists of Bluetooth Module (HC-05), Arduino Uno (ATmega-168 processor), two servo motors (MG-995) and a micro servo (SG-90).

The Bluetooth module sends the serially received data to Arduino Uno which then calibrates the orientation values into corresponding number of degrees. The orientation data is fetched from Z-axis of Accelerometer and Azimuth of Orientation sensor present in mobile.

The Z-axis values are mapped to servo motor which rotates the gun in up and down direction and Azimuth values are mapped to servo motor which rotates gun in left and right direction. The trigger of the gun is operated by another servo which is controlled by a pushbutton. The optimum angle rotation of gun mount is decided based on the base structure and size of the gun.

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.

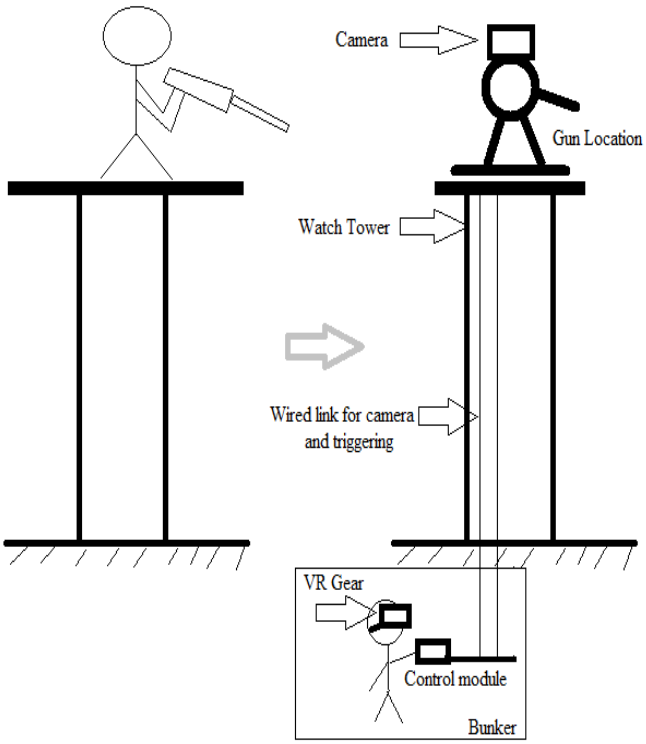

Fig 1: Present Scenario and Proposed Work

2. EXISTING METHODOLOGY
A 3-axis accelerometer (ADXL335) chip placed on hand detects acceleration in three planes i.e. roll, pitch and yaw and hence recognizing the gestures of hand. However only two planes i.e. roll and pitch is used. The accelerometer sends this data over the Inter-Integrated Circuit (I2C) wired connection. The controller used is the Arduino Uno R3 that also supports I2C bus. The Arduino calibrates the orientation data into corresponding number of degrees. 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 [1].

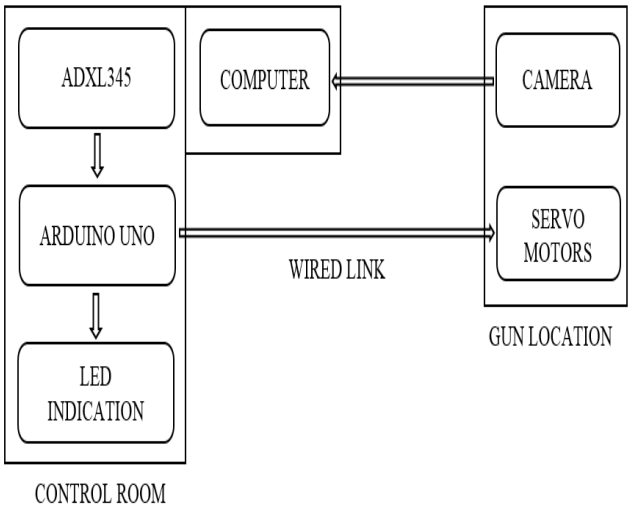

Fig 2: Block diagram of Existing System

3. PROPOSED WORK

In this paper, wireless control of the gun through Bluetooth is implemented which allows the soldier to operate gun through head movements by wearing Virtual Reality Gear. Which means soldier can move gun in direction his head moves and also he can see visuals of where the gun is pointing. At the beginning stages of project Wi-Fi was considered for both video transmission and also controlling the gun and Node-MCU to implement. Lot of issue were faced in video quality and transmission lag. Bluetooth was selected for controlling position servo motors and Wi-Fi for video transmission [8] for final prototype. The Mobile application was developed first using "MIT App Inventor" to communicate serially to Bluetooth module (HC-05) [11] connected to Micro-controller.

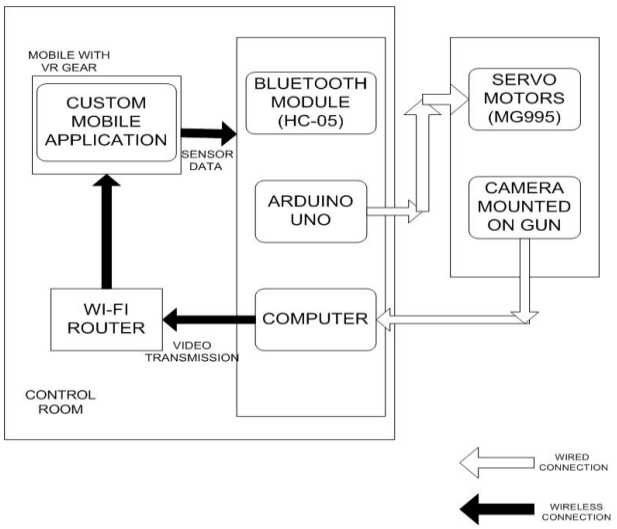

Fig 3: Block Diagram of proposed work

Mobile application was developed which could fetch sensor data from mobile and send it as a single string serially to Bluetooth module (HC-05) [11]. Problems on timing and "Broken pipe" of serial communication were faced. When the communication speed, delay interval of transmission was set [5], Arduino IDE program was developed which would reconstruct the string using constructString() function [4] and also separate the values coming as single string using delimiters (eg. : ; " % & etc.) based separation and would map it to

Fig 4: (a) Pseudo code of Arduino program; (b) Pseudo code of Mobile Application.

corresponding servo motors i.e. accelerometer Z – Axis value was mapped to servo for up and down movement of gun and Azimuth value of Orientation sensor [10] was mapped to servo which controlled left and right movement of gun which leads to pan and tilt mechanism [2]. Baud rate of HC-05 was also changed from default value of 9600 bps to 19200 bps using AT commands and achieved faster response time from the system.

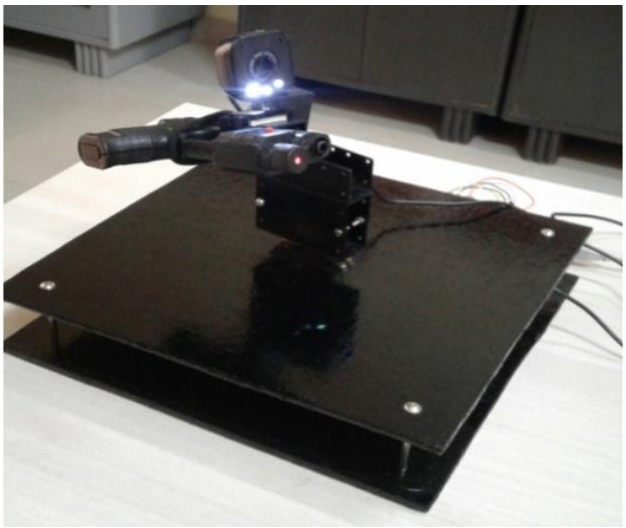

Fig 5: Project Prototype

3.1. Mobile Application

The mobile application was developed using MIT App Inventor software [7] which makes app development easy without java coding. The application used mobile's inbuilt Bluetooth to connect to the HC-05 module using SSP [9]. Once the connection is established with module it will start sending concatenated string containing sensor values. "CAM" button on the Application screen is made to initiate "Web Viewer" option .Once CAM button is pressed mobile application pings the local IP address of the computer [6] to which webcam is connected through USB connection. Two web-viewers are put on screen side by side at 50% of screen side so that the Virtual Reality (VR) gear focuses both screen to form one visual. The Laser on the gun was placed in such a way that it points to the mid-point of visual screen.

Fig 6: (a) Screenshot of Mobile application; (b) Virtual Reality Gear with Mobile running the application

4. FLOW CHART

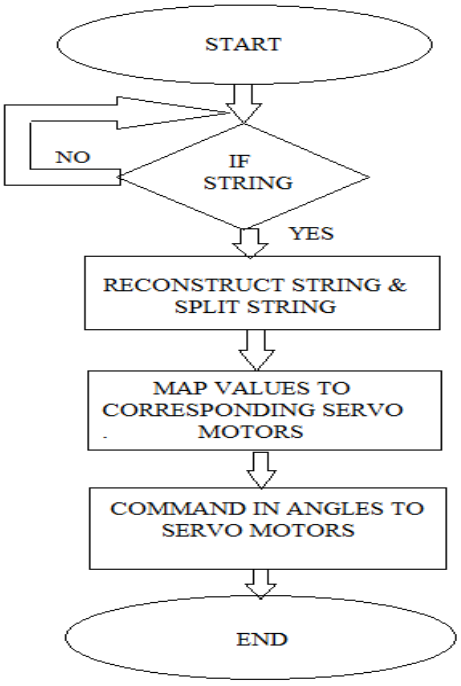

Fig 7: Flow Chart

When program is initialized, string received serially through Bluetooth is reconstructed and is then separated into two sub strings which carry values of sensors (accelerometer and Orientation sensor). These values are mapped to corresponding motors and expected output is obtained. The Arduino also sends operation data to serial window. This whole program repeats for infinite number of times.

5. COMPONENT INTERFACING

5.1. Servo Motor Interfacing

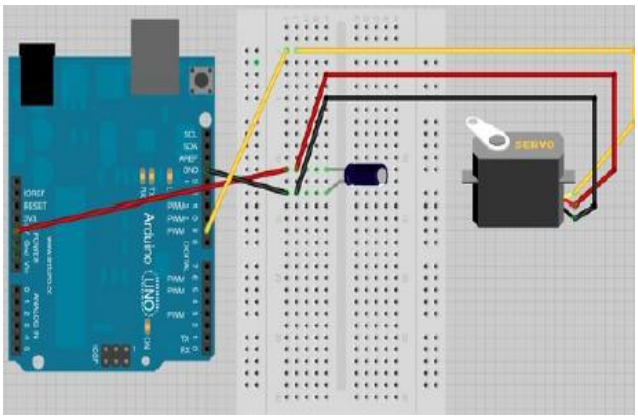

Fig 8: Servo motor Interfacing

The servo motor (MG-995) has three pins. The color of the pins varies between servo motors, the red lead is always 5V and GND is brown. The other pin is the control pin and this is usually orange or yellow. This control pin is connected to PWM (Pulse width modulation) pin 9. The servo motor is terminated in a header into which we can push jumper wires, to connect to the Arduino UNO [3].

The servo motor draws lot of power during start up, and this sudden high demand of current causes voltage drop in the Arduino board and affects its performance. This is eliminated by adding a high value capacitor of 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 and reduces the voltage drop effect.

5.2. Bluetooth module interfacing

The HC-05 package comes in two flavors, SMD and breakout board versions. The breakout board has a 3.3V regulator which can convert Arduino's incoming 5V power but we still had to drop the Arduino's 5V pins down to 3.3V.

b

```
Turn ON Bluetooth of mobile
Select BluetoothClient from the List
   if(BluetoothClient connected)
        Enable Accelerometer Sensor
        Enable Orientation Sensor
   end if
Access Gun vision via URL specified
Concate Accelerometer Z axis & Orientation Azimuth of mobile
Send concated string to BluetoothClient connected
```

Fig 9: Bluetooth Interfacing

The simplest way is a voltage divider from two resistors. 2K & 1K resistors are used as voltage divider to drop the Arduino's 5V TX pin to 3.3V, which is the operating voltage of the HC-05 pins. This is done to protect the HC-05 3.3V RX pin. On the other hand, the Arduino 5V RX pin can handle the 3.3V sent from the HC-05 TX pin.

6. APPLICATIONS

- Can be used for reconnaissance or surveillance.
- Can be deployed along the borders and in remote areas for security.
- Can be deployed on the watchtowers of jails and places where high security is needed.
- VR Gear controlled guns can be deployed on warships replacing human counterparts directly involved in combat.

7. FUTURE SCOPE

- Mobile can be replaced with a dedicated display device which has more accurate sensors and is embedded within Virtual Reality Gear.
- Dedicated camera can be used for higher quality visuals, higher mega pixel and higher FPS (frames per second).
- Thermal imaging can be implemented to detect target at night time.
- Artificial Intelligence and machine learning can be used to completely automate the system and increase accuracy.
- 360^0 rotating servos can be used to achieve complete movement for complete 360^0 security.
- High quality armors can be added to reduce damage to system while heavy firing from target side.

8. CONCLUSIONS

A system that can control the direction of a gun through wireless communication is designed through remote control mechanism by capturing the head movements of a soldier. The project presently is just a proof of concept and was implemented with resources available. This project can be improved drastically for real time application by using high end technical components. This wireless control mechanism with Virtual reality gear replaces soldier at check posts and borders where high surveillance has to be maintained and reduces the death risk of soldiers, monitoring high security from enemies in the battle field. It can also be used in the situations of Riots and curfews and anti explosive camera can be used for protection from the firing. The control mechanism can not only be used as proposed in the paper but also can be implemented with drones with the gun attached and these drones can be used for defense applications and confidential operations of national security.

9. ACKNOWLEDGEMENTS

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