Firearm Security for Prevention of Accidental Deaths due to Guns

Major project report submitted in partial fulfillment of the requirements for the degree of

DUAL DEGREE (B. TECH and M. TECH)

Submitted by

Ritwik Duggal,185528

Himashi,185539

Akshay Thakur,185541

Sanjay Gollamandala,185552

7th Sem, 4th year, CSE Dual

Under the guidance of

Dr. Nitin Gupta

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY HAMIRPUR

HAMIRPUR, HIMACHAL PRADESH -177005 (INDIA)

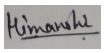
Department of Computer Science and Engineering
National Institute of Technology Hamirpur
Hamirpur(H.P), India-177005

Candidate's Declaration

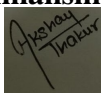
We hereby certify that the work which is being presented in the report entitled **"Firearm Security for Prevention of Accidental Deaths due to Guns"** in partial fulfilment of the requirements for the award of the Degree of Master of Technology and submitted in the Department of Computer Science and Engineering of the National Institute of Technology Hamirpur, is an authentic record of our own work carried out during a period from July 2021 to December 2021 under the supervision of **Dr. Nitin Gupta**, Assistant Professor, Department of Computer Science and Engineering, National Institute of Technology Hamirpur.

The matter presented in this report has not been submitted by us for the award of any other degree of this or any other Institute/University.

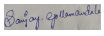
Ritwik Duggal



Himanshi



Akshay Thakur



Sanjay Gollamandala

This is to certify that the above statement made by the candidate is true to the best of my knowledge and belief.

Nitin Gupta

Date: **Assistant Professor**

ACKNOWLEDGEMENT

It is a great pleasure for us to express our respect and deep sense of gratitude to our major project supervisor **Dr. Nitin Gupta**, Assistant Professor, Department of Computer Science & Engineering, National Institute of Technology Hamirpur, for his wisdom, vision, expertise, guidance, enthusiastic involvement during the course of our CSE dual degree at NIT Hamirpur. We are exceptionally obligated to him for showing us both composition and research abilities which have demonstrated to be gainful for our current research and future profession. Without his unlimited endeavours, learning and tolerance this exploration would not have been possible. It has been a significant privilege and joy for us to do inquire about under his watch.

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Ritwik Duggal 185528

Himanshi 185539

Akshay Thakur 185541

Sanjay Gollamandala 185552

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Chapter 1

Introduction

Gun Safety is very important in order to prevent unintentional injury, illness or death, or any use of the firearm against the will of the owner. [1–4] Gun Safety is necessary for training and usage as most of the accidents that happen with guns can be avoided and loss of life can be avoided. [2] Gun Safety is not just restricted to a Safety switch but now as more and more incidents happen, more modern methods are required such as proper authentication and security, and methods that can protect from intentional gun violence. [**?**,2,5] In Major countries, such as the U.S., these methods are a very big necessity due to the laws which have a tendency to protect gun use. [4]

1.1 Objective

Through this project We have aimed to create a system which has the following methods:

- **In-built authentication:** Instead of the authentication from an external source, a biometric authentication will be built-in.
- **Camera Safety:** A camera will be attached near the barrel aim, which will be automatically turned on, and a photo will be clicked when the shot is fired.
- **Pressure Pad:** The handle of the gun will have a pressure pad, if the pressure is below

the threshold value, the gun won't unlock even with the biometric authentication.

- **Gyroscope:** A gyroscope will provide the real time orientation and position of the gun, when the shot is fired we get this data as well to have an estimation on where the gun was aimed when the shot was fired.
- **Alarm Safety:** When the gun is off Safety and there is a human in the frame, a red light will pop up and after the shot is fired, the authorities would be sent a notification as well.
- **Pulse Rate:** A pulse rate sensor to check if the user was under stress when the shot was fired.

1.2 Motivation

As we see in day-to-day life, gun violence incidents tend to occur more and more, gun safety can help prevent these and keep a check on gun violence incidents.

We need more innovative methods which have the use of technology such as:

- **Authentication**
- **Enhanced visual check**
- **Check of accidental fire**
- **Alert for the authorities**

These methods can help prevent most gun violence incidents, which occur. And the use of these methods can assist users under distress.

1.3 Problem Statement

The current gun security models are developed by some companies and those models are gun specific. Also, their methodology does not provide an assurance for the security. So, we aim to achieve the following with this work:

To design a smart-firearm model with biometric authentication and gyroscope for viewing gun orientation and position. YOLOV3 to identify the person in the view of gun and then flag that person and send a alert to nearby police station.

1.4 Report Layout

The report contains five chapters. Brief details about each chapter are as follows:

Chapter 1 : Introduction : This chapters introduces the problem of firearm security through IoT, gyroscope sensor, ESP32 Cam module and YOLOV3. Moreover, the objective, motivation and problem statement for the research work has been defined and lastly, an overview to the layout of this project report work.

Chapter 2 : Literature review : This chapter discusses the work done by other authors in the domain of gun security, their proposed articles and approaches.

Chapter 3 : Proposed work : This chapter discusses about the scenario overview, system model used in this research.

Chapter 4 : Simulation and results : This chapter contains the evaluation of the proposed model and the proposed schemes done through simulation.

Chapter 2

Literature Review

This section presents several recent approaches to firearm gun security.

Correlation between access to guns and risks of deaths in Canada is proposed as mentioned in A chapdelaine et al. [1].

Need of changes in guns to make them safer, gun owner responsibilities for reducing firearm violence is proposed as mentioned in David Hemenway [2].

Risk of firearm injury to young children and other persons due to unsafe storage practices of firearms is proposed as mentioned in Edward F. Vacha et al. [3].

The increasing rate of Unintentional Firearms deaths among young Americans due to firearm prevalence is discussed as mentioned in Archie Bleyer et al. [4].

Various firearms authentication techniques like RFID, Fingerprint detection, Palm detection, Grip detection are proposed on different gun models as mentioned in GREENE, M. [5].

A Survey on 34 children aged between 4-7 is taken.Parent and kid reports of parental gun ownership were found to be significantly different, as were parents' expectations about their children's interest in guns. The present study's findings put doubt on the effectiveness of skills-based gun safety programmes for kids as mentioned in HARDY, MARJORIE S. [6].

Nicholas Buttrick in [7] Reviewed work from across the social sciences to model the psychological utility that people get from gun ownership.

Ergonomics study to understand the safety dynamics of firearms is discussed as mentioned in Michael A. Cornell [8].

Unauthorized gun possession or use is associated with higher rates of firearm violence than legal possession of guns is mentioned in National Research Council [9].

In our work we proposed a portable system for all gun types, Authenticated access system, Authenticated user addition system, Face detection, Image will capture and store in database and notify to the user.

Chapter 3

System Model & Proposed Work

In this section, we describe an **overview of the scenario**, how we are trying to implement the system for firearm security.

3.1 Technology Used

In our aimed methodology, we have:

- **Internet of Things(I.o.T.):** Using the IoT technology we intend to use a Microcontroller, interfaced with a gyroscope, camera, pressure sensor, along with a biometric sensor.
- **Machine Learning:** Using facial recognition we can find exactly where the shot was fired in the frame, using the gyroscope readings we also get the orientation of the gun, therefore we can predict the intention of the shot, was it a violation or an act of self-defense.
- **Web/App development:** This is to monitor the use of the gun and will be helpful to route messages to the authorities when the gun is fired, and can also be used to add the biometrics.

3.2 Setup

Piezoelectric Pressure Sensor and biometric fingerprint sensor have been interfaced with the Arduino Board which is our main microcontroller for the entire setup. For the functionality of photos and the communication using WiFi, the Esp32 CAM has been interfaced which makes it possible to send all the readings, image when constantly the trigger is pressed.

The pressure sensor sends the value to the Arduino, if it is higher than our threshold value then the biometric sensor is activated and the fingerprint is read. Then, if the fingerprint is correct, the gun is unlocked.

When the trigger is pressed, the reset button of the Esp32 CAM is pressed which causes a reset, the image from the CAM is clicked and sent to the server.

Then the YOLO model is deployed in the app, where the human in the frame is captured and using the gyroscope readings, it is determined whether the shot fired was an act of defense or a crime in action.

3.3 Deployment

For the deployment an app is created, in which there are mainly two types of accounts:

- **Admin Account**
- **User Account**

In the user account the user has the functionality to see their data, and manage their authentication.

In the admin account the photograph is received and there is a list of authenticated users, when a human is detected in the frame of the shot, the user is immediately flagged and is analysed to check if a crime has been committed.

The app is built using Flutter, and the coding on the I.o.T. device is done using the Arduino IDE.

3.4 Working of Mobile Application

The mobile application consists of five main screens. *Figure 3.1* shows the Login screens for firearm security apps.

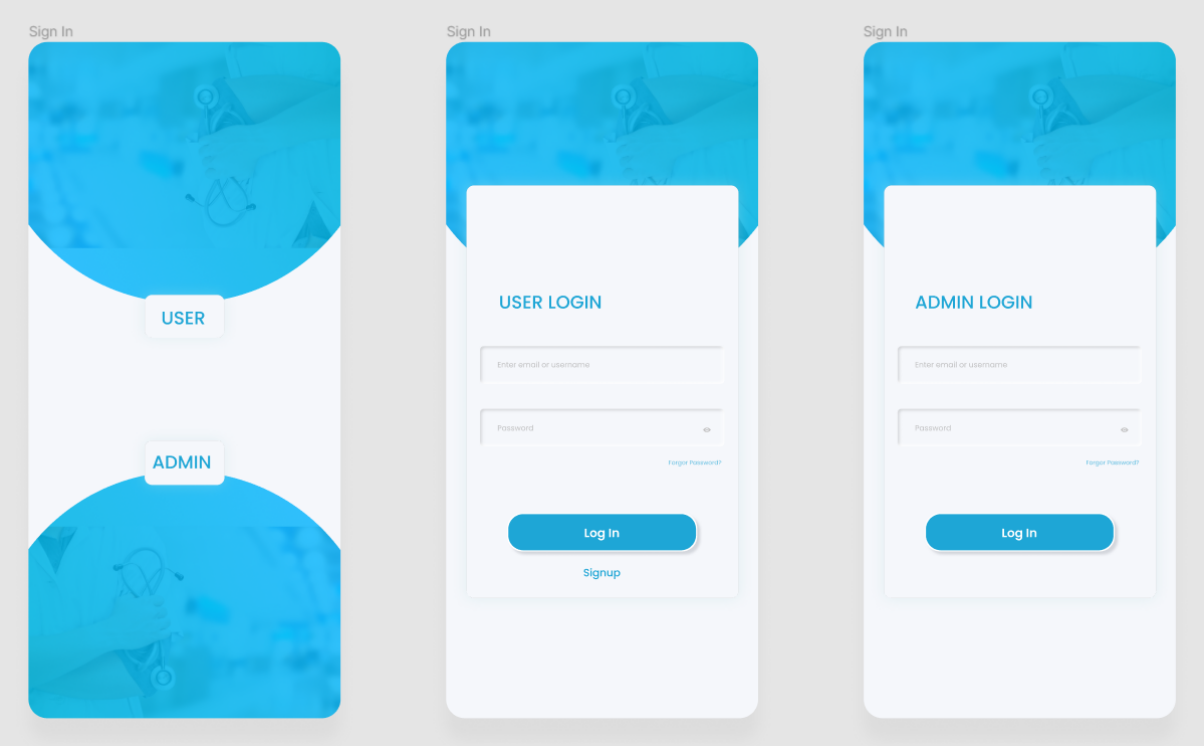


Figure 3.1: Login screens

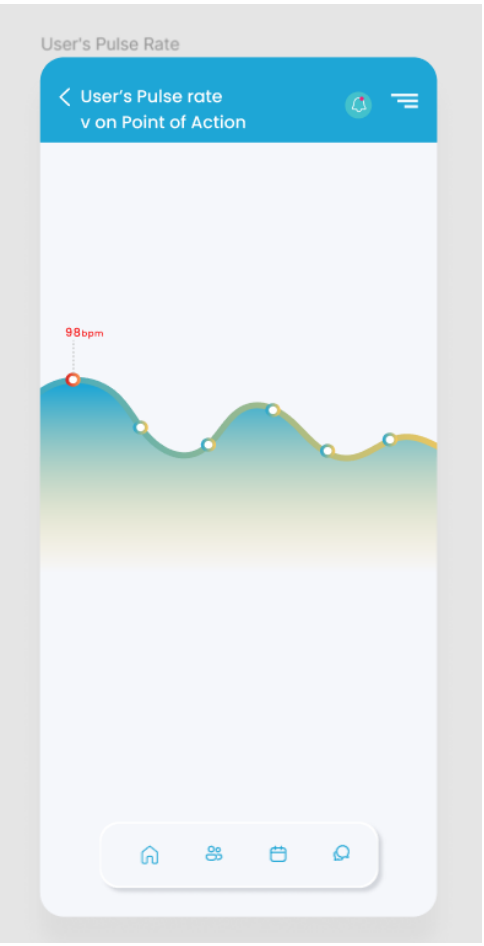
User Registration-User registers in the mobile application using the user id. The data (Name, Phone Number, User-id and Password) of the user is then stored in the Firebase Database.

User Login-After registration, a user can login using his credentials(phone number and password) through any device.

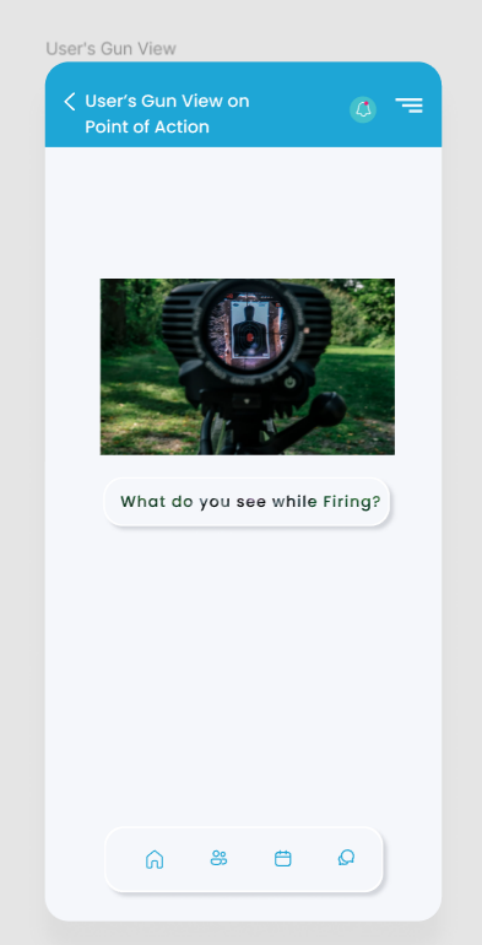
User Pulse Rate Monitor:*Figure 3.2a* is the user pulse rate monitor screen to monitor the user's pulse rate if the user was under stress when he fired.

User's gun view: *Figure 3.2b* is the user's gun view screen to view the aim and orientation of the gun.

Figure 3.3 is our current prototype image in which ESP32cam capturing image and storing on local server.



(a) Pulse rate monitor screen



(b) User's gun view screen

Figure 3.2: User's Screen

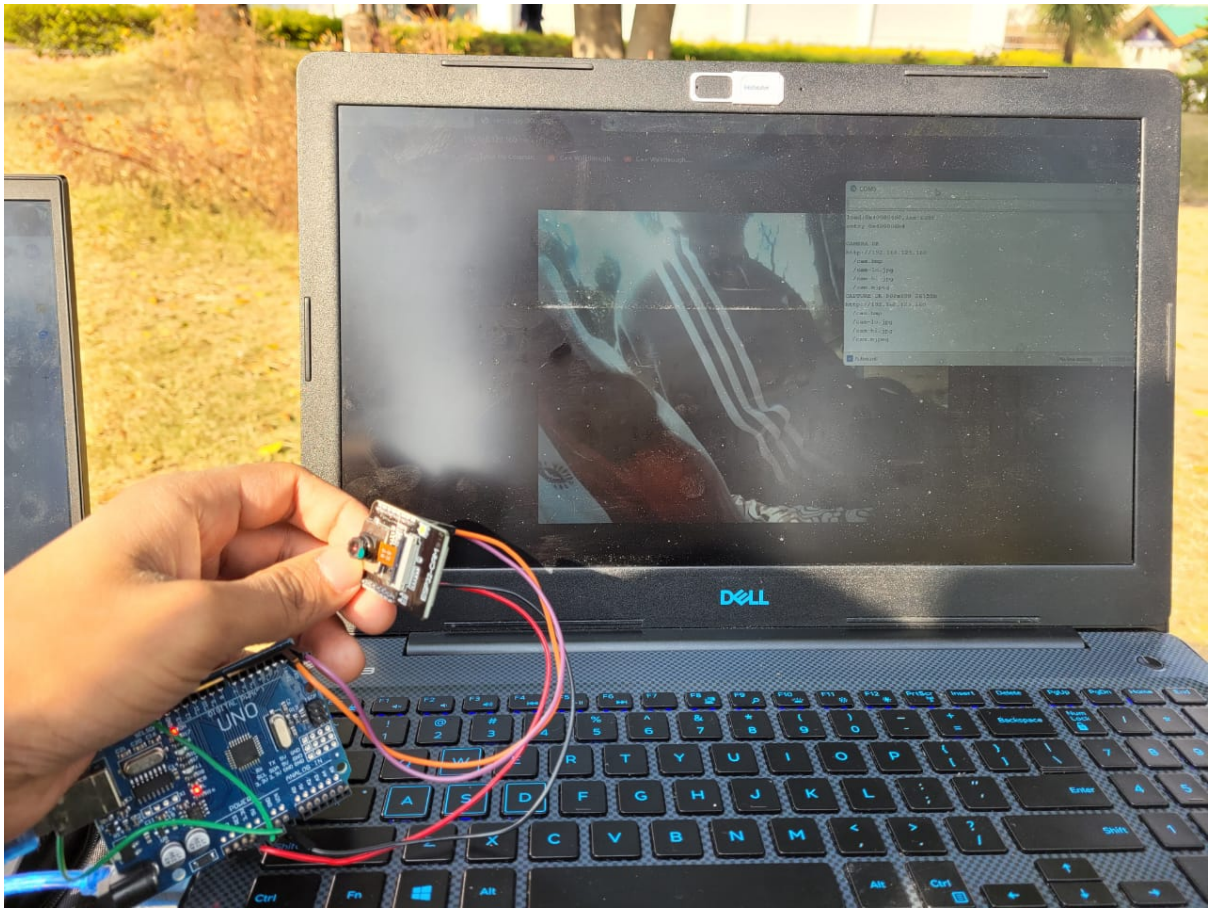


Figure 3.3: Current prototype image

Chapter 4

Simulation and Results

Gun Safety is very important in the modern world, with the rising cases of gun violence it is a necessity that a check is kept on the gun users and to judge if the actions committed are a case of self-defense or a crime in action.

In this project an efficient prototype has been developed, as a single unit. This unit has all the combined individual components of I.o.T., Web development and Machine learning allowing us to address the problem statement.

With this project, a check is kept on all the gun users and the relevant authorities can be notified on time, when the deed takes place. This allows for the safety of the victim as well, and would help prevent the unnecessary firing of guns.

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