International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 12 | Dec 2021 www.irjet.net p-ISSN: 2395-0072

Smart Watch Ensuring Safety and Security

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Abstract - *Considering the global scenario, various problems faced by people are rapes, harassment, kidnapping, murder and many more problems and that are increasing day by day. Thus, to overcome such problems we developed an integrated wearable device" Smartwatch" which is able to overcome dangerous situation by communicating directly to the nearby police station. This project has the details about the design and implementation of "Smartwatch". The device consists of Raspberry Pi 3 (micro controller), Neo 6M (GPS module), PI Camera (v2 Pi module) and the system having the software side in that a web application is used to provide the interface for police control room for surveillance and some neural network techniques will be used to detect the potentially dangerous threat to the user. In this project, when a user senses danger he/she will trigger the panic key. When the device is triggered, it starts to track the current location of the user with the help GPS module and live video feed will be started which will be sent to the server for automatic threat detection by neural network techniques and then sent to the web application of police control system for manual surveillance by the police. Due to the small size of the device, it can be carried anywhere and the process time is also fact, thus leads the police to take the action in no time. In the proposed methodology an approach is demonstrated which can be very helpful in returning desired outputs.*

Key Words: **Smart Watch, Raspberry Pi, GPS Module, Machine Learning, Threat Detection, FRCNN Algorithm**

1.INTRODUCTION

As today's world can be also known as Digital World, where computerization has benefited most fields like commercial, industry, education, scientific, sports, etc. As we see crimes happening around us are at the highest rate and we do not have any robust system which can help to reduce crimes. People often get stuck in dangerous situations and it is so difficult to call the police in a panic situation like murder, kidnapping, and rape and it is raising day by day it is becoming a nightmare to the public, police, and Government itself. So, the challenge for us is to make a technology which directly communicates with police and provide help in any panic situation to the public. We are using systems that are outdated or working inefficiently like dial 100 for emergencies (in India). According to the survey, around 10,000 calls are received in a police station but only around 300-500 calls are useful which needs attention. So approximately only 5% of calls are legit, remaining calls are blank calls or useless calls. Due to this, police can't act properly and moreover efficiently and the manpower gets wasted and the most important thing a victim suffers and criminals play their games successfully. Due to this worthless system, the normal public didn't get proper help from the police and become a victim and suffers.

So, with the help and contribution of the police system, we will create a smart handy watch, which helps users when they are in any dangerous situation by pressing a panic button which is installed in a smartwatch. As the button of the device is triggered using the button the location of the user and surrounding images will be transmitted to the police system. Getting informed from the victim's current location [5] police server will contact the nearest police station [2] to provide help to the victim as soon as possible. To detect the actual threat from our system we are using Image Processing techniques [7]. The images which we are getting on the police servers [10] by the watch will be analyzed by the system through various algorithms to detect the actual threat. So, when the user presses the panic button without any legit purpose system will detect and the police will make the decision, whether to go for help or not. Along with the system, police can also manually go through the situation with the help of images.

Due to this Smartwatch, we can reduce the crime rate to some extent and make a police system very efficient [3].

In the given chapter, problem statement, objectives and the scope of the device is explained in depth. Problem definition defines our inspiration to build this software. Objectives covered the goals to achieve when using the device. Scope determines the user usage and understanding of how it can be helpful to reduce the crime in the world.

1.1 Faster-RCNN Convolutional Neural Network

Faster Convolutional Neural Network is a deep learning model mostly used for object detection in the images. The speed of the object detection in FRCNN is much faster than any other model by building the model region based. It is much faster and accurate then Region based convolutional

neural network by developing a single stage network. The architecture is shown in figure 1.

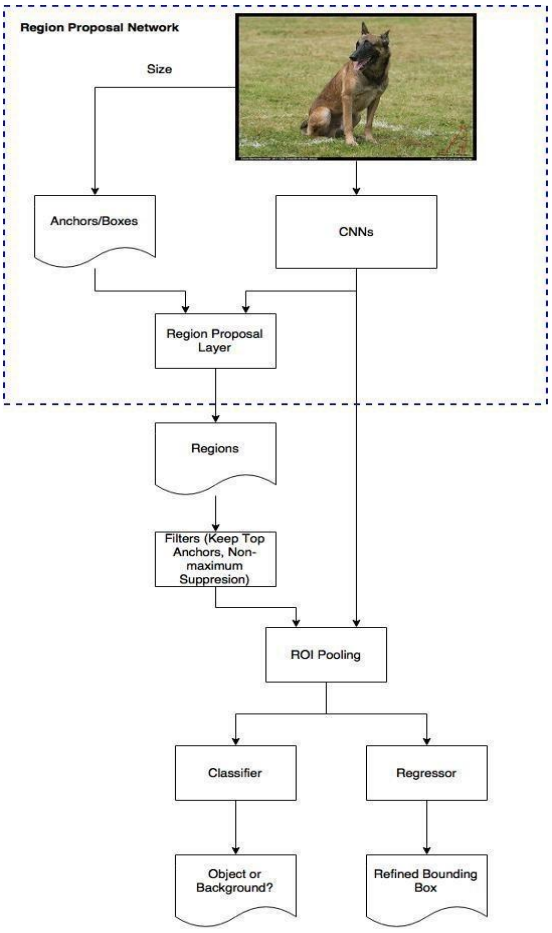

Figure 1: Architecture of Faster RCNN

1.2 Dataset Gathering

We have collected almost all types of images to train them on an FRCNN model for threat detection. We gather all the images from the Internet Movie Firearm Database (IMFD) which has all the movies, games and animes images of guns, knives, blood, etc.

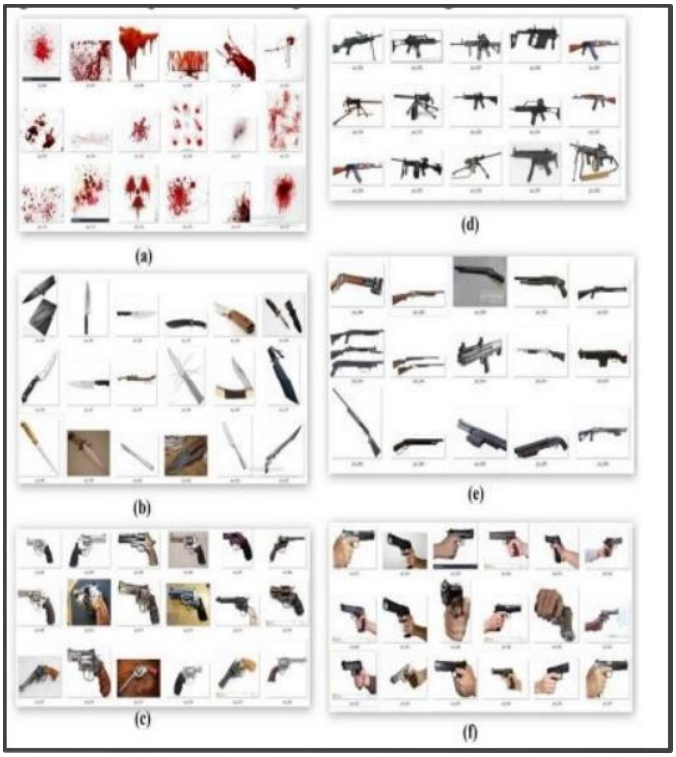

Figure 2: Objects Dataset

1.3 Methodology

1.3.1 Raspberry Pi

The Raspberry Pi 3[4] uses a Broadcom BCM2837 SoC clocked at 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache and the graphics capabilities, provided by the Video Core IV GPU. We used Raspberry Pi 3 Model B as the main computing unit for processing of data of photo and GPS module sending it to the control system. Key Application:

1. Webserver
2. Wireless Access point
3. IoT Application
4. Server/Cloud Server
5. Security monitoring

Figure 3: Sample Raspberry Pi 3 Model B

1.3.2 Raspberry Pi Camera

One of the main objectives of the project is to take a video and send it to the police control room. For this purpose, we require a camera module which can take pictures of high quality and with a fast shutter rate. Thus, for the project we have used a Raspberry Pi Camera which has a 5 mega pixel camera, which captures images as well as videos at different frames.

When all other modules of the project are connected then Raspberry PI 3 Model B including the camera. After triggering the panic key camera will send the recorded video to the server.

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Figure 4: Raspberry Pi Camera Module v2

1.3.2 Raspberry Pi Camera

Global Positioning System (GPS) acts like a receiver that receives signals sent from the satellites from any position in the world and using that signal GPS tracks the exact location of the signal coming from [13]. In the smartwatch there would be a pre-built satellite which would send the required signal and using GPS the location of the user is detected. GPS only receive the signal it does not transfer any signal ahead.

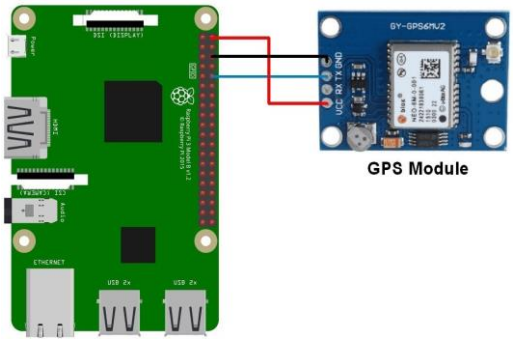

Figure 5: GPS Module Interfacing with Raspberry Pi

1.4 Problem Statement

When people are in their home city or go away from their home city to different cities for their work, studies, fun, etc. they do not have any security for themselves, if they get into any dangerous problem, they won't get enough time to call for help to police in many situations. What to do at that moment?

1.5 Objectives

Availing the users, a rapid panic button [1] which will aid them in any possible way by the police. By just pressing the panic button when necessity is required by the user. Creating a robust system for police so they can work efficiently. Currently, the police system has many drawbacks like blank calls. So, giving them the latest technology system would be very beneficial. Transmit data to the servers as fast as possible. So, users can get help as soon as possible

1.6 Scope

Our system will be useful to the police system and for the benefit of common people. By giving the users a Smartwatch so they can contact the police whenever its need and police can help people whenever they ask. The system will be more beneficial when it is installed in many more cities. As users going to another city, we should have our police servers in that city too. So that city police can help the user. So we need to scale the police system in the whole country for good results.

2. LITERATURE REVIEW

The below section discusses about various research papers that are associated to the project.

2.1 Critical Evaluation of Research Papers

2.1.1 Design and Implementation of Women Safety System Based on IOT Technology [11]

The paper explains the development of a" Smart Wearable device/band". In this project, if women detect issue or any danger, the required device is long pressed and activated,

which sends the location of the user using GPS to the police station and the given mobile number which sends helps as soon as possible. Glassfish servers are used to store and manage to perform required operation. Using non-lethal electric shock which are produce using Neuro stimulator in danger type situation to detect the location of attacker.

The device is activated when SOS button is clicked for two seconds. When the device is activated, message like," I am in danger, please help me" along with GPRS location, blood oxygen levels, heart beat rating and movement recording, with an alert beep sound at the receiver end. It contains the secret webcam in the locket captures the culprit photo which is directly uploaded to the server. Location is traced using android application. If volume button is pressed for twice an alert message is passed, followed by a long press of volume button result into a call to the police station to nearby location.

2.1.2 Low Cost Real Time System Monitoring System Using Raspberry Pi [8]

This paper denotes the design and implementation of a low-cost system monitoring based on Raspberry Pi, a single board computer which follows Motion Detection algorithm. The motion detection implemented in Raspberry Pi works on the principle of how pixels change the location, for each frame (frame differencing). The method searches for object change in the image: The problem with these motion detection methods is that it does not detects slow moving objects, because of the sensitivity of the threshold. Due to too much sensitivity in the threshold, it detects changes in sunlight and even shadows. Even face issues for detecting rotation-based object. If no motion then no data would be saved.

Results: The control panel with control options to save stills and capture a picture, time lapse, change the resolution of videos. When movement occurs, the system will analyze incoming images and store the most important item. We also can watch videos on mobile devices, it's got a smooth set of controls, reliable performance, and a clear picture with no blips, glitches.

2.1.3 Camera Surveillance Using Raspberry Pi [9]

Camera based surveillance system using Raspberry Pi it will be used as a 24x7 surveillance system without even considering of restart and reboot once installed. The system is built using Raspberry Pi and highly scalable to add more sensors and increase the range of the system. Once the photo is clicked it will be sent to the user messaging app. This makes sure the data will be secure and copy of the data will also be made in case of any failure of the system leads to the deleting the data or damage of the system. This paper focuses on the use of Raspberry Pi based camera security system due to its high power and efficiency, performance capacity along with interfacing with sensor and other modules. When the sensors detect the warm body in the room it will take pictures and send it to the user.

2.1.4 A Handheld gun detection using Faster R-CNN Deep Learning [12]

In the given paper, using VGG-16 and VGG-19 researchers build a convolutional neural network with MatConvNet for CV (computer vision) applications. As the name indicates in VGG-16 CNN model there are 16 convolutional layers with 'SoftMax' as an activation function, trained on Image Net dataset with images on generic object classes.

During training of the model using the Image Net dataset, the VGG-16 model is built and trained by altering the logistic regression objective and using mini-batch gradient decent process. Rescaling is performed alongside training for using the fixed size image while training. As the dataset contains 1.28 million images, the training time takes hours/days for training, thus to increase the training speed parallelization is introduce on the GPU to the mini-batch gradient descent process for calculating the gradients. The evaluation of the model is calculated using accuracy of the model, FDR (False Detection Rate), FPR-TPR (False/True Positive Rate), Positive Prediction Value (PPV). For inter-class similarities/variation the developed model works accurately. For the classification three machine learning model are used SVM (Support Vector Machine), KNN (Nearest Neighbor), and Ensemble Tree model.

Support Vector Machine outperform compute to other classifiers with classification accuracy 92.6% with Fine Gaussian algorithm and KNN having 91.5% accuracy with Cosine KNN algorithm and at last Ensemble tree with Boosted tree algorithm having the 93.1% of accuracy.

2.1.5 An evaluation of deep learning-based object detection strategies for threat object detection in baggage security imagery [6]

This paper presents the importance of object detection and threat detection using some of the most important deep learning algorithms mainly Faster RCNN and YOLO. Object detection is one of the integral parts of Computer Vision technology. Using YOLO and FRCNN, X-ray-based threat detection framework is built. The database for object detection is created in two steps, by variability and for increasing the object count in the images x-ray image modelling is preferred.

The number of images after pre-processing the dataset after x-ray modelling and by bringing variability are up to 3669 images by combining the original image and modelled image. Following are the time taken by the model for training on the given dataset for 5000 iterations are:

1. Tiny YOLO: 2.12 hours
2. YOLOv2: 5.37 hours

3. FRCNN: 4.94 hours

Considering accuracy of the model for selecting the best model among the three FRCNN model performs well with an accuracy of 98.4%.

2.2 Existing System

2.2.1 Advantage

Connect to the Control Room by just dialing 100. Free and emergency Services. Send a message alert to three family members.

2.2.2 Disadvantage

It takes lots of time to respond. In other states/ cities rather than native one it's not applicable.

2.2.3 Limitations

We cannot call someone in a kidnapping or murder case. We have to give identification and tell our address to reach police. In other cities/states rather than native one it's not applicable.

3. PROPOSED METHODOLOGY

This section deals with the proposed research and methodology. It shows detailed and deep insights into the experimentation associated with the project. Also, future working of the project is presented.

3.1 Introduction of Proposed Methodology

We took many surveys and after analyzing the situation found out that to make the system efficient and crime-free environment. We will use an Embedded System for developing a Watch and Image Processing techniques for analyzing the images for threat. And we'll use Networking techniques to transmit data from Watch to Servers.

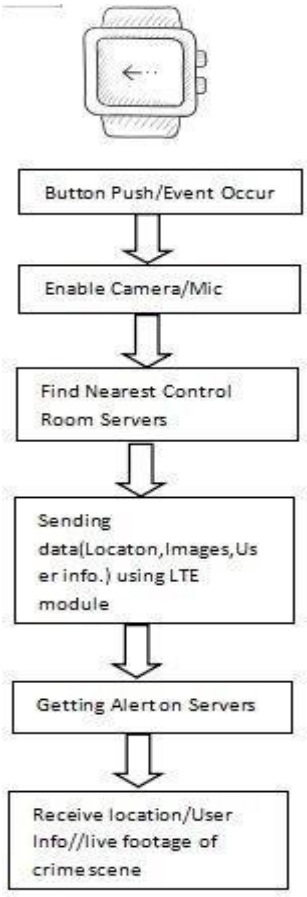

Figure 6: Workflow

When the user will press the panic button in dangerous situations. The current coordinates will be sent to the nearest police servers and captured images will also be sent to servers for analyzing the actual situation along with the user's personal information like name, contact number, photo. After analyzing the situation by the system and police, action will be taken accordingly by calling the nearest police station from the victim.

Advantages: An efficient system will be created as police will get legit complaints by the users and won't get that much blank calls. The rate of crime will be reduced because people will have a quick device that will contact the police within seconds. User will feel safe as someone is already for them. Digitization in-country is increased. As police system will have new technological systems and users have high tech smartwatch which will help them from dangerous situations.

Disadvantages: User Acceptance, People should be enlightened to use this device because, it can help them in many possible ways. Cost, making a device can be costly which can't be affordable to normal people but it can be reduced by making devices in a lot.

3.2 Feature detection of the object from an Image

Initially, feature detection of an object will be done for threat detection with the help of the SIFT detector. A KD Tree

algorithm will be used to detect the feature distance and masking will be done for better matching of the feature object.

After that, we will be using the Faster Region Convolutional neural network (FR-CNN) for object detection by making an anchor for different sizes and then identifying the objects from the pictures.

Figure 7: Gun Object

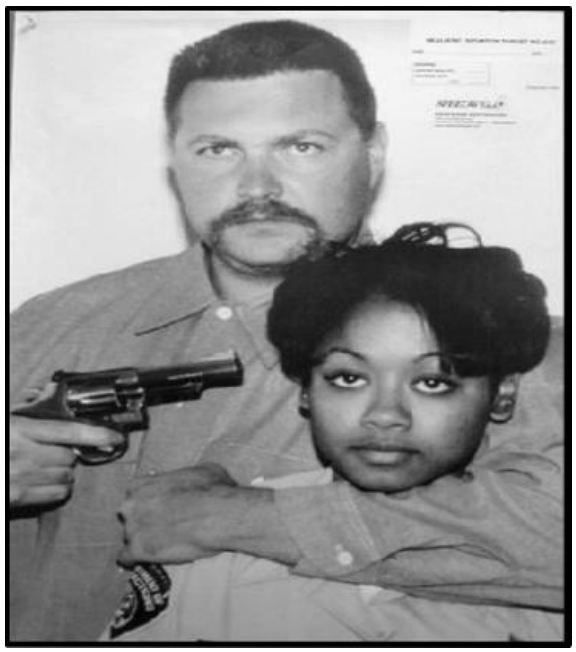

Figure 8: Captured gunman image

Figure 9: Object Matched from an Image

3.3 Software Web Application

With the help of a web application, an interface will be provided to the police control room for surveillance of the user. As soon as the panic key is triggered, location and video are sent to the police control room and showed them on the web application. We have used the .NET Framework in the visual studio for creating the web application. For Frontend, HTML, CSS, JavaScript is used to develop the look and feel of the web application. For Backend, C# and jQuery is used to write the functionality of the system which will be integrated into the interface. Below is the software prototype of a web app.

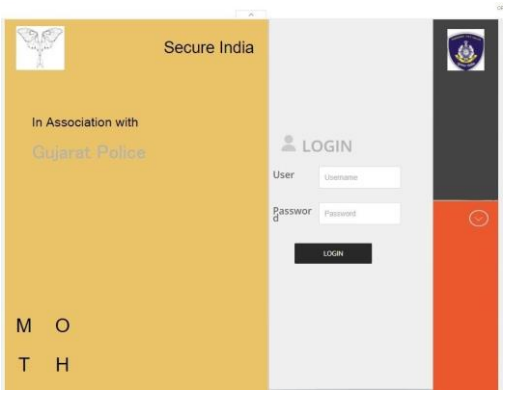

Figure 10: Web App Screen -1

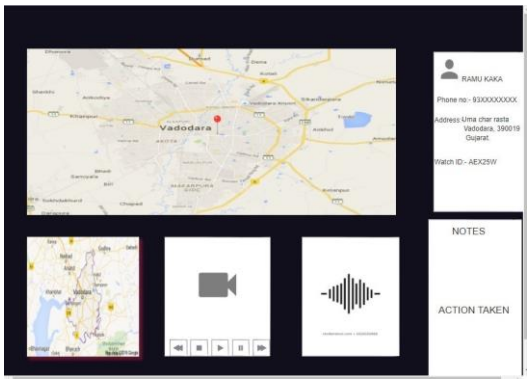

Figure 11: Web App Screen – 2

3.4 Workflow of the proposed system

The workflow of the smartwatch system is explained in this section.
Step 1: Start.
Step 2: The panic key is triggered.
Step 3: If GPS receives the signal, GPS will start calculating the current latitude and longitude values of the victim and sent it to the web app which is on the police control room system.
Step 4: Camera is ON (as the panic key is triggered) and starts to record the video of surrounding and sent it to the server. This step will basically send the data from Raspberry PI to the server.

We will unpack the image and check for the length of an image as 32 bits. After reading the image length we will read the image with the help of python libraries and converting them into the array then making the stream of frames into the video.

After establishing the socket connection with the server. PI Camera will begin to take the pictures as per the mentioned resolution with the pause of 2ms it will take pictures continuously and pack the images into bytes format and then flush it to the server.

Step 5: Recorded video will be analyzed with the help of neural network techniques and try to detect the potential threat as shown earlier.
Step 6: If the threat detected by the algorithms, then that case will be prioritized into the police system and video will be shown to the web app of that case for a quick response and if system won't be able to detect any threat then the video will be manually surveillance by police.
Step 7: Police will take action according to the data gathered

4. RESULTS & DISCUSSIONS

The resultant accuracy from the experiment came out to be 80.37%. The result was good as expected as the images of each object taken was approximately 500. Due to machine constraints and limitations, it was not feasible to train more images. FRCNN algorithm was efficiently able to identify the threat and was able to transmit the data further in the process.

5. CONCLUSION & FUTURE WORK

We have proposed an efficient approach to deal with the fast-paced growing crime rates. Our System would be having an embedded system that will act like a smartwatch. A smartwatch that will have a GPS module for locating the device and camera module for taking a live video feed of surroundings that will help as a threat detection input. A video will be feed to the neural network algorithm in terms of pictures to find the 7 potential threat objects. All GPS locations and analyzed video feed will be sent to the web application that is on the police control systems for manual surveillance. In future work, we would be dealing with an internet connectivity problem which is a very potential limitation of our system. In another proposed idea will be having another sensor that will let know about the watch like when any other person snatches the watch, we will get to know.

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