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Terrorist Detection System Using Raspberry Pi to Avoid Cross Border Terrorism

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ABSTRACT: Now- a-days, terrorist attacks became very normal worldwide. Cross border terrorism is increasing day by day due to support of neighbouring countries. Recently, terrorist group suddenly attacked the Indian army base at Uri and had taken the lives of our brave Soldiers. Entire world knows that Indian army never steps for war and always stand for establishing Peace. To prevent these kind of causalities and to save the soldier lives from such tragedy, we as patriotic engineers want to help the army with knowledge by implementing a system, that would be used to alert our security personnel when there is any movement of suspected people around borders.

KEYWORDS*:* SVM, Open CV, HOG, Raspberry Pi, GSM, Wiring Pi, Pi Camera.

I. INTRODUCTION

In present days all are very much aware about the safety concerns. By knowing about the attacks done near by our country border, we want to reduce the attacks by detecting the enemy using our system.

This paper proposes and implements a prototype satellite based system to detect suspected people using Raspberry pi, Pi camera, GSM module. This system also issues alert messages when any suspected human or non-human gets detected around border. The system consists of Raspberry Pi acting as processing and controlling engine interfaced to GSM module for SMS alert, SD card where the input images are stored. We implement human detection algorithm using OpenCV. The application reads the input images, divide the image into several blocks for block based processing and search as for human in each block. The process is repeated at multiple scales so that we can detect humans in the input image at different sizes. Each block undergoes a sequence of machine learning operations like - histogram computation, gradients calculation, binning process and finally classification using SVM (support vector machines). Finally, if any human or non-human is found in the input image, an alert message is sent to the army officials for further investigation.

II. LITERATURE SURVEY

Our project idea is to prevent attacks on our Indian army. Raspberry Pi, an innovative product available at low cost in present market is also easy to handle as it has additional advantage of credit card sized single board. The basics, hardware and RC4 algorithm implementation with raspberry pi boards for UART communications are given in [1]. Having developed from statistical learning methods, SVM has many key achievements in notable fields. It overcomes the drawbacks of data dimensionality and limited samples. An efficient learning and classification technique, support vector machine is used on varied data having multi classes and proved to give satisfactory results [2]. GSM has its place in cellular communication and all over the globe now-a-days. A multi security system using GSM and PIC 16F877A could receive a call or text message from a remote mobile, subsequently message is delivered and is used for control of home appliances. In the next step, message decoding follows and is used for control of home appliances [3].

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III. OVERVIEW OF THE PROPOSED SYSTEM

A. *BLOCK DIAGRAM*

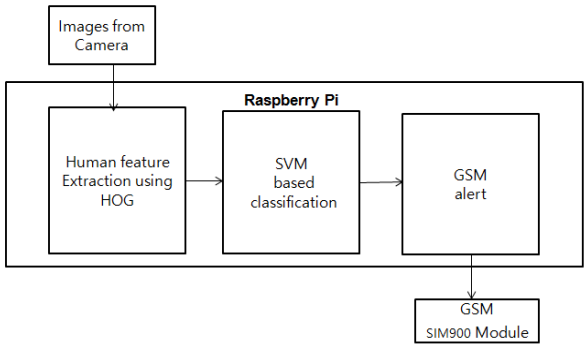

Fig1. Block diagram of the system

Fig.1 clearly explains the whole proposed system. The main components are the RASPBERRY PI processor, picamera and GSM module, Raspberry Pi consists of three sections viz., as Histogram Oriented Gradients(HOG),Support Vector Machine(SVM) and GSM SIM 900 Module. We installed OpenCV library for the purpose of SVM and Wiring Pi for the purpose of GSM. The images taken from the camera are given as the inputs to the processor. The processed data will be send as SMS alert, If any suspected person detected at the border to convey to the army official about the situation for further investigation, gets clear description of the components in the system are given below:

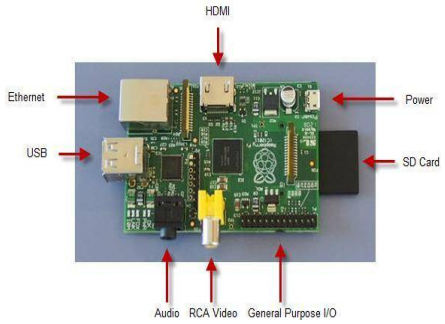

Fig2. RASPBERRY PI [1]

The **Raspberry Pi** is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside of its target market for uses such as robotics. Peripherals (including keyboards) are not included with the Raspberry Pi. Some accessories however have been included in several official and unofficial bundles, Fig. 2. [4]

LINUX is the operating system installed in Raspberry pi. Linux is a Unix-like computer operating system assembled under the model of free and open source software development and distribution.

Specifications:

- CPU: Quad-core 64-bit ARM Cortex A53 clocked 1.2 GHz.
- GPU: 400MHz Video Core IV multimedia
- Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz)
- USB ports: 4
- Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack

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- Network: 10/100Mbps Ethernet and 802.11n Wireless LAN
- Peripherals: 17 GPIO plus specific functions, and HAT ID bus
- Bluetooth: 4.1
- Power source: 5 V via Micro USB or GPIO header
- Size: 85.60mm × 56.5mm
- Weight: 45g.

PIN DIAGRAM:

Fig3. Pin diagram of Raspberry PI [7]

B. PI CAMERA

A **camera** is an optical instrument for recording or capturing images, which may be stored locally and transmitted to another location, or both. The images may be individual still photographs or sequences of images constituting videos or movies. The camera consists of a small (25mm by 20mm by 9mm) circuit board, which connects to the Raspberry Pi Camera Serial Interface (CSI) bus connector via a flexible ribbon cable. Fig.4 The camera's image sensor has a clear resolution of five megapixels and has a fixed focus lens. The software for the camera supports full resolution still images up to 2592x1944 [9].

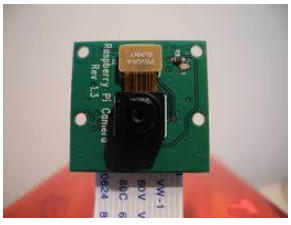

Fig4. PI CAMERA

C. MOTION DETECTION

Motion detection plays a fundamental role in any object tracking or video surveillance algorithm, to the extent that nearly all such algorithms start with motion detection. Actually, the reliability with which potential foreground objects in movement can be identified, directly impacts on the efficiency and performance level achievable by subsequent processing stages of tracking and/or object recognition.

D. HISTOGRAM OF ORIENTED GRADIENTS

The **histogram of oriented gradients (HOG)** is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized

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portions of an image. This method is similar to that of edge orientation histograms, scale-invariant feature transform descriptors, and shape contexts, but differs in that it is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy.

E. OPENCV LIBRARY

OpenCV (*Open Source Computer Vision*) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel's research center in Nizhny Novgorod (Russia), it was later supported by Willow Garage and is now maintained by Itseez. The library is cross-platform and free for use under the open-source BSD license. We installed OpenCV library for the purpose of Support Vector Machine (SVM).

F.SUPPORT VECTOR MACHINE

The first thing we can see from the definition, "The goal of a support vector machine is to find the optimal separating hyper plane which maximizes the margin of the training data", is that a SVM needs training data, which means it is a supervised learning algorithm. It is also important to know that SVM is a classification algorithm, which means we will use to predict if something belongs to a particular class Fig.5 [2].

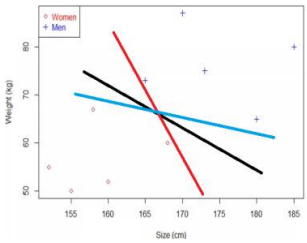

Fig 5. SVM Classification

G. DIFFERENT IMAGE COLLECTIONS TO TRAIN SVM

- Images from personal digital image collections are taken over a long time period.
- Usually the original positive images were of very high resolution (approx. 2592x1944 pixels), so we have cropped these images to highlight persons.
- Many people are bystanders taken from the backgrounds of these input photos, so ideally there is no particular bias in their pose.
- **INRIA DATASET**: It is a default website that is used for the collection of images for all object detection projects. Folders 'Train' and 'Test' correspond, respectively, to original training and test images.

Fig 6. Original Images

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Fig 7.Normalised Images

H. ***WIRING PI LIBRARY***

Wiring Pi is a *PIN* based GPIO access library written in C for the BCM2835 used in the Raspberry Pi. It's released under the GNU LGPLv3 license and is usable from C, C++ and RTB (BASIC) .*Wiring Pi* is maintained under GIT for ease of change tracking [6].

I. ***GSM (GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS)***

Fig 8. GSM SIM900 Module

GSM was developed by the European Telecommunications Standards Institute (ETSI) which de-scribes the protocols for 2G cellular networks used in mobile phones. It is operating over 219 countries and territories. GSM is implemented using narrow band time division multiple accesses (TDMA) and is used in various digital wireless telephony technologies. The data is digitized, compressed and sent through a channel (which may have other users) during its time slot. The frequency band is 900MHz or 1800MHz. As the GSM operators are globally agreed upon, they allow the users to use their same mobile phone in different countries by changing the SIM card Fig.8 [3].

IV. HARDWARE IMPLEMENTATION

Fig.9 shows the hardware implementation of the system. Here the receiver pin and ground pin of GSM module is interfaced to the transmitter pin and ground pin of Raspberry Pi processor respectively .The Pi camera is connected to the Raspberry Pi .This Raspberry Pi process receives information from the inputs and gives necessary instructions to GSM Module.

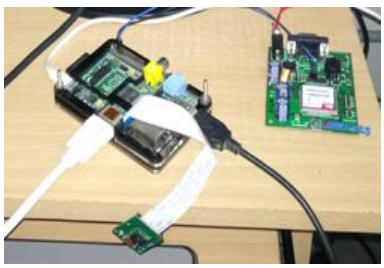

Fig.9 Hardware Connections

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V. RESULTS

Some of the results that are obtained, when the suspected people are entering in to our border are included and shown here .Finally, if any human or non-human is found in the input image, an alert message is sent to the army officials for further investigation.Fig.10

Case 1:

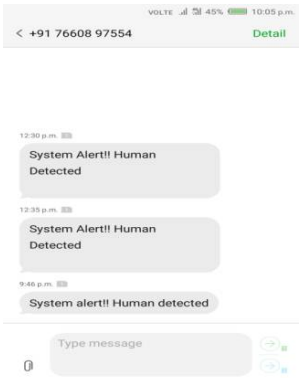

Fig10. Alert Message for human detection.

If the motion is detected near the border by the camera, the images will compute the HOG features and load into SVM model. The SVM classifies whether it is human or non- human. fig10. Shows the result of issuing the message alert, if human is detected near the border and message is issued by the GSM module.

Case 2:

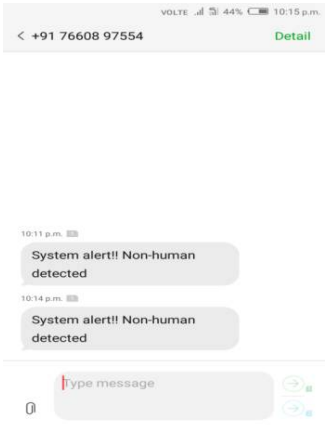

Fig.11 Alert Message for non-human detection.

The fig.11 shows the result of issuing the message alert, if non-human (any object/animal/any other products) is detected near the border and message is issued by the GSM module.

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VI. METHODOLOGY

- Installing LINUX on SDCARD and bringing up Raspberry Pi system
- Building and cross compilation of OpenCV libraries for Raspberry Pi.
- Creation of sample applications and testing on Raspberry Pi.
- Image collection of humans from top angles for SVM training.
- Creation of Support Vector Machine (SVM) model on Raspberry Pi.
- SVM testing and model parameter tuning.
- Building Wiring Pi library and cross compilation for Raspberry Pi.
- Understanding GSM Module AT Commands, flowchart preparation.
- Implementation of SMS sequence in Embedded C.
- Interfacing GSM module with microcontroller and testing.
- Integration of SVM Model Code and GSM code
- Testing the Final application, results reporting & demonstration.

VII. CONCLUSION

By using this project we can save the lives of our army people. The Indian Army has forever been known for its courage and valor. They have protected us at times when our survival was doubtful, and have given their lives to save ours. Every Indian is proud of the Indian Army and we present this project as a salute to our Army men. Jai Hind!!

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