



## IMPLEMENTATION OF COST-AWARE ADABOOST AND SENSOR NETWORKS IN DISASTER MANAGEMENT ROVERS

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**ABSTRACT** Disaster management is always a big challenge for the governments in present days. Due to the technological development which leads to the creation of huge buildings, which increases the risk of loss of life. Disaster may be either manmade or natural. Present technologies are not integrated to solve many problems such as automation, self-detection and machine learning possibilities of the Rovers. We are integrating common technologies like mechatronics, Wi-Fi, and Virtual Network Computing to implement cost-aware AdaBoost image processing technique. The Rover is built on a Broadcom ARM cortex, BCM2837 is used as Development board. This enables the system to run an Embedded Linux kernel as the operating system. The images collected are processed using a computer vision API and go through sensor data and detection. The prime aim of Rover is to get trained to detect human body parts. This system have great accuracy compared to conventional robotic systems. A GUI is also build on python engine for interactive control

**KEYWORDS :** human detection, pir sensor, humidity sensor, gas leakage, low cost, AdaBoost algorithm

### I. INTRODUCTION

Natural disasters like Earthquakes, floods, Tsunami and manmade disasters bomb explosion, building collapse often occur which causes death of many peoples. Humans are getting increased knowledge in the concept of intelligent rescue operations in such calamities so as to save precious life. There are many natural and man-made disasters that occur without any advanced information. They produce a shocking result and find no variance among human and material. It is important to formulate events for both pre and post disasters to ensure safety to public as well as the environment. In recent years, automation and robots have been applied at different platforms to coordinate in distributed systems. A robot is a machine designed to execute many task continuously, with speed and precision. A real time rescue system save the people who are buried under the building parts and wounded due to a disaster. In such situations, rescue system must have to take fast resolutions under force from higher order, and get victims from disaster area to safe location at their own risk. The saving system must gather the position information and status of people who trapped and save as quickly as possible so that medication team can enter the disaster area and save people by using AdaBoost image processing technique. All these works are done mostly in very hazardous and risky situations by human and trained dogs. This system by using both human and trained dogs becomes time consuming and due to the vast area that gets it becomes more difficult.

So the project proposes a mobile robot that moves in a disastrous area and helps in detecting the human body parts. And the gas leakage detection also implemented in this system. By using sensor the atmospheric humidity condition also checked. By using gsm the location of detected human body can be identified and the rescue process become easy.

### II. PROPOSED SYSTEM HARDWARE

The project introduces a cost aware mobile robot that moves in the disaster area and which helps in detecting the live and dead people those are injured and performs rescue system operations. Hence due to the real time detection of victims precious life can be saved without the help of huge number of rescue operators. The hardware system consists of a single board computer section, sensor network, motor and driver ic. Figure below shows the block diagram of alive and dead human detection robot using AdaBoost image processing technique

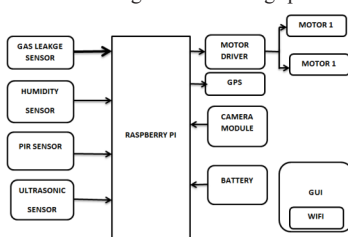


Fig. 1: Block diagram of human body detection robot

### Working

When a disaster occurs we send our rover into that area. The camera module present in the rover takes the images continuously, as the rover moves through the disaster prone area. These captured images are compared continuously with preprogrammed images. When the captured and preprogrammed images matches the rover sends the image to the user via email. The rover checks whether the detected human is alive or not by using a PIR sensor and the corresponding message is also send to the user. Hence the rescue operations can be carried out effectively. The rover can be operated in both automatic and manual mode of operation. During automatic mode if an obstacle comes in the way of the rover it turns right and the scanning process is carried out

**A. Raspberry:** The Raspberry Pi is a sbc. The operating system used is Raspbian. Raspberry Pi was opted owing to it's excellent image processing capabilities and Video Core graphics processor. The RPi is capable of implementing image processing algorithms with the help of image processing libraries. Open Source libraries like Open CV can be easily integrated into the system. The USB camera can be easily interfaced to the module for image capture. The memory card of the RPi is sufficient for storing the database images and vectors. The GSM module can also be integrated into the RPi via its USB port

**B. camera module:** A camera module is a video camera, that feeds its image in real time to a computer. When captured by the camera, the video stream be saved, viewed or sent on to other networks via the internet, and emailed as an attachment. When this sent to a remote location, the video stream is found to be saved, viewed or on sent there. Unlike an IP camera (which connects using internet or Wi-Fi), a webcam is connected by a USB cable, or built into computer hardware, such as laptops

**C. passive infrared sensor:** The passive infrared sensors are more sensitive when compared with other sensors. it consists of two slots. These slots are made of a special material which is found to be sensitive to infrared radiation. the two slots of the passive infrared sensor can see out past a little distance. When the sensor is not active, then the two slots sense the equal amount of infrared radiation. The amount radiates from the outdoors, walls, etc. When a human body or any animal passes the sensor, then it captures the first slot of the passive infrared sensor. This produces a positive differential change between the two slots. When a human body leaves the sensing area, the sensor produces a negative differential change between the two slots

**D. ultrasonic sensor :** Ultrasonic sensors produces short, high-frequency sound waves in an equal interval of time. These transmit in the air at the velocity of sound wave. If they hits on an object, then they

are reflected back in the form of an echo signals to the sensor module, which computes itself the distance travelled to the goal based on the time spent between emitted signal and receiving the echo. Round-trip of the ultrasonic sensor means that the sound wave traveled two times the distance to the object before it was detected by the sensor; it contains the travelling from the sonar sensor to the object and the 'travelling from the object to the Ultrasonic sensor

**E. gas sensor:** MQ-6 is a simple sensor, suitable for sensing the amount of concentrations in the air. Sensor composed of mostly propane and butane. The MQ-6 can detect concentrations of gas anywhere from 200 to 10000ppm. This sensor provide high sensitivity and fast response time. The sensor's output is an analog resistance value.

**F. humidity sensor:** In DHT11 The humidity sensing component is a moisture holding substrate with the electrodes are applied to the surface of the body.

Water vapor is found to be absorbed by the substrate present in the sensor, and ions are released by the substrate. This released ions increases the conductivity between the electrodes. The change in resistance is found between the two electrodes. This change in resistance is proportional to the relative humidity. This relative humidity and the resistance between the electrodes are inversely proportional.

**G. motor driver IC and motor:** A motor driver IC is an ic chip which is used to control motors used in an autonomous robots. Motor driver ICs act as an interface between microprocessors and the motors in the robot. the L293 series are L293D, L293NE, etc. These ICs are designed to control 2 DC motors at the same time. L293D consist of two H-bridge circuit. Hbridge is the simplest circuit for directing a low current rated motor. Here using L293D has 16 pins. Most microprocessors operate at low voltages and which require a small amount of current to operate while the motors require a higher voltages and current This is the primary need of using the motor driver IC.

**DC motor:** Is an electric motor that runs on DC electricity. DC motors can operate directly from rechargeable batteries and which requires at least one electromagnet. This electromagnet switches the current flow as the motor turns and changing its polarity to hold onto the motor running. The electromagnet is located in the centre of the motor which turns within the permanent magnets.

**H. GPS module :** The GPS engine module is SKG13BL, which provide ultra low power and small form factor. The GPS signal is given to the antenna input of module, and a complete serial data message give position, velocity and time information is presented at the serial interface with custom protocol. The integration with portable device like mobile phones, cameras etc become easy due to the characteristics such as Small form factor and low power consumption.

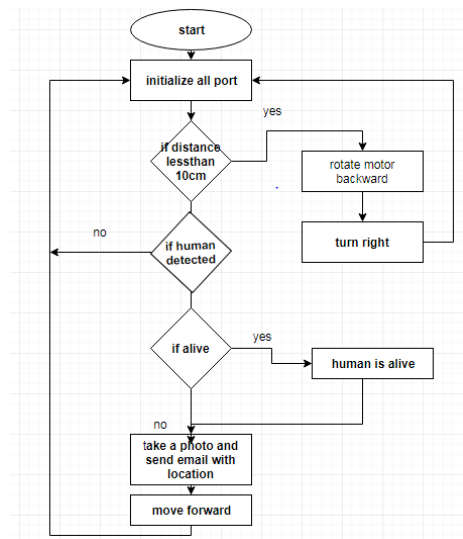
**III.SOFTWARE DESCRIPTION**

**A.Python Programming Language:** Python is a general-purpose high-level language and its design philosophy emphasizes code readability and its syntax allows programmers to express concept in fewer lines of code than would be possible in language such as C.python is a scripting language and it includes object oriented concepts and also powerful language, easy to learn and use.

**B.virtual network computing :** VNC is a desktop sharing system graphically. that allows to control remotely the desktop interface of one computer from another computer or mobile device. VNC Viewer transmits the keyboard and either mouse or touch actions to VNC Server, and which receives updates to the screen in return. the desktop of the Raspberry Pi inside a window on computer or mobile device.

**C.open cv:** Open Source Computer Vision Library is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.

**Flowchart and algorithm**



**Haar cascade classifier algorithm**

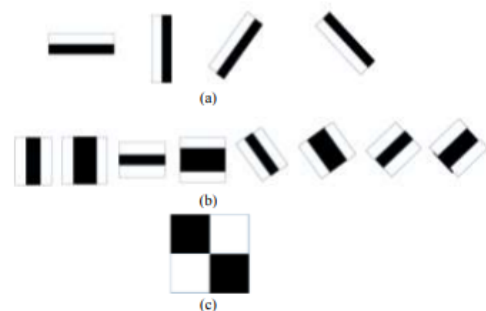
Viola Jones introduces A very fast and accurate approach to detect an object. Basically using 4 stages of algorithms to find and track human body parts

- Haar features
- Integral image
- AdaBoost
- Cascading

**Haar like features**

This features are used to detect variation in the black and white portion of the captured images. This forms a single rectangle around the detected images. Some commonly used Haar features are:

- Two rectangle feature.
- Three rectangle feature.
- Four rectangle feature



The value of two rectangle feature is the difference between the sums of the pixels within each rectangle, in three rectangle feature subtract the sum of pixel under centre rectangle from surrounding rectangles, in four rectangle type feature subtract the sum of pixels of corner rectangles.



**Integral image**

This used for quick feature detection. The integral image is the outline of the pixel values in the original images. The integral image at any location the sum of the pixels above and to the left of corresponding location inclusive. example given below

1	1	1
1	1	1
1	1	1

Input image

1	2	3
2	4	6
3	6	9

Integral image

**Adaboost machine learning method**

AdaBoost is a machine learning boosting algorithm capable of constructing a strong classifier through a weighted combination of weak classifiers. A weak classifier is mathematically described as

$$h(x, f, p, \theta) = 1 \text{ if } pf(x) \geq p\theta$$

$$0 \text{ otherwise}$$

Where x is a 24\*24 pixel sub-window, f is the applied feature on images, p the polarity and  $\theta$  the threshold. Which decides whether a 24\*24 pixel sub-window should be classified as a positive or a negative. Since only a small amount of the possible 160,000 feature values are expected to be potential weak classifiers the AdaBoost algorithm is modified to select only the best features.

**Cascade classifier**

The cascaded classifier is collection of stages each containing a strong classifier. The main function of each stage is to determine whether a given sub-window is definitely a positive image or maybe a negative image. When a sub-window is classified to be a negative image by a given stage it is immediately discarded. Conversely a sub-window classified as positive images is passed on to the next stage in the cascade. It follows that the more stages a given sub-window passes, the higher the chance the sub-window actually contains a detected human body part.

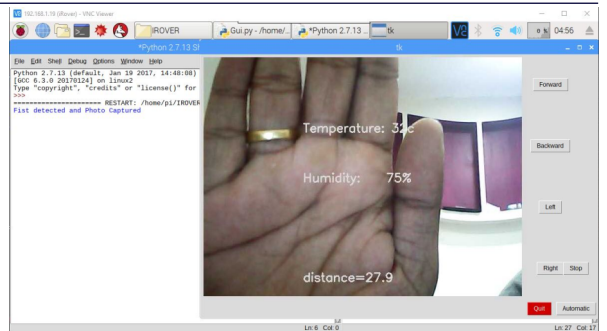
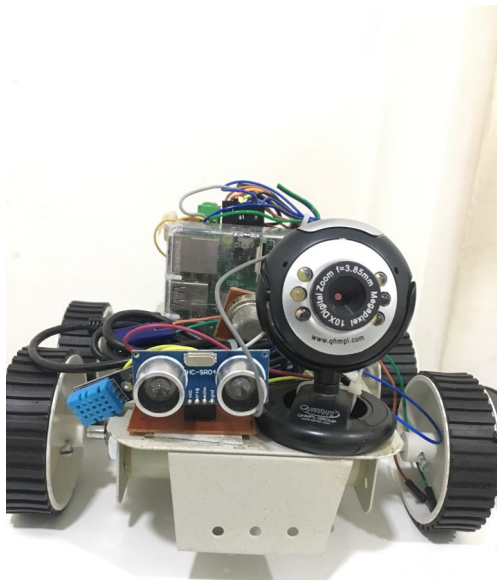
**IV. ADVANTAGES**

- Used in disaster zone, whether it is natural or manmade disaster.
- In military applications to detect presence of militants.

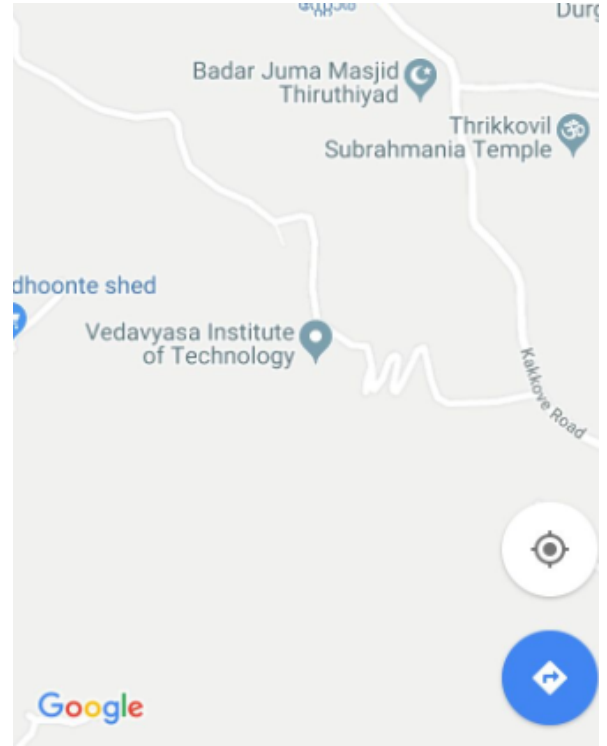
**V. RESULT AND CONCLUSION**

We have completed the software section of our project. That includes detection of human body parts such as eye, face, fist and all other body parts. Hence many lives can be saved by using this autonomous vehicle during a disaster in a short duration which becomes time consuming and unaffected if done manually. The wireless sensor network will improve the saving of many lives by using mobile rescue robot in disaster area.

**VI. HARDWARE OF ROBOT**



After detecting body part it will send a mail captured photo and location



**VII. REFERENCES**

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