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Pre-Monitoring Robot for Military Application

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Abstract: ***In today's world security is a very vital factor. An electro-mechanical machine that is robot can perform tasks automatically. The pre-monitoring system can be used for a security system in hazardous areas. Surveillance is achieved by deploying workforce near sensitive areas in order to continuously examine the changes. The main objective behind this paper is to develop a robot that will perform an act of surveillance in military areas. This robot will spy the areas before the war and give an idea about the environment there. It will capture and archive real-time video and all data from the robot using the inbuilt camera. We can use a robot with manual control or automatically based on the requirements. Wi-Fi module will be provided for premonitoring areas. Additionally, it will have face detection, object detection, obstacle avoidance, and such relative features. The anticipated security solution will be integrated by a camera on raspberry Pi 3 B+. Raspberry Pi 3 B+ will operate and control video along with records for future playbacks.***

Keywords: Raspberry Pi 3b+ based camera, Robotic wheel, SD card, Surveillance system, Wi-Fi module, Internet.

I. INTRODUCTION

Surveillance is the process of monitoring situation of area or person. Human surveillance is achieved by deploying sensitive areas in order to constantly monitor the changes. In advances technology over the years, it is possible to remotely monitor area by using robots replaced by humans. By using them with high-resolution cameras and various sensors, it is possible to achieve information about the particular area remotely. Thus, in recent times, surveillance technology or pre-monitoring the area has become an area of great research interest. This generally occurs in a military scenario where surveillance of border side and enemy territory is essential to a country's safety. Using high-resolution cameras and different sensors, it is possible to gain information about the particular location remotely.

The main principle of our robot is the principle of Humanity based on basic three laws of the robotic system. It is designed to replace human beings in various hazardous areas. To overcome the complexity of wired communications, we are using advanced wireless RF and Wi-Fi technology. The control signal from the transmitter is sent to the receiver which is connected to a device or vehicle that is to be remotely controlled. Similarly, this project mentions a wirelessly controlled commando robot controlled using radio frequency technology.

This robot will pre-monitor the areas which need to be under surveillance for security purpose. Even additional features of face detection, object detection, video surveillance is done. The specific human pictures can be send on the cloud for a backup procedure. If a robot is in the Wi-Fi range there is no need of internet.

II. LITERATURE SURVEY

The field of Surveillance organization is completely well admired. The number of researches has been carried out in navigational procedures and circuitry system of wireless surveillance robot. A common motivation is usages of a camera on the robot in order to receive live video stream at receiver. Several research works are done so far surveillance system. Some inventive research works have been successfully approved. Various authors discussed various aspects of different types of observing activities and tracing applications [1]. The wireless robot made using the Arduino microcontroller have been implemented, but wireless communication occurs using the Zigbee protocol, which limits the range of the robot[2].

A robot which performs image processing using the camera on an Android smart phone has also been implemented[3]. In an Arduino based robot is designed which use Bluetooth technology to control robot and Wi-Fi network to transmit the video. In this system, the robot and controller both should control the robot. The field of the surveillance system is exclusively well popular. The number of researches have been carried out in navigational processes and circuitry of wireless surveillance robots. They placed PIR sensors for human footstep acknowledgment purpose to captured sensory data and establish a training based algorithm that helps in definite intruder recognition in the open environment [6]. The existing system is unique in the sense that, it is a low-cost solution that we can automatically control a robot from any range (by using the internet) and also offers the live video transmission. There is no constraint on any extra processing as everything is done from remote location [7].

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III. PROPOSED SYSTEM

The objective is to use the robot for a premonitoring system on a Wi-Fi network. The surveillance system grant conference choice and its output are controlled by cloud throughout internet connection. This model also includes night vision in a monitoring system and to move and turn to a particular direction using mobile application. The data loss occurs by network failure is limited via the memory over the robot itself. This system is helpful for people in dangerous areas, where life threat and the possibility of losing the property is more. Another motivation is to decrease expenses in companies, labs, and factories. People may use easy and inexpensive security system in their homes.

DC motors are used for the movement of robotic wheels and used for camera movement i.e. for vertical movement and horizontal movement. The PIR sensor on the robotic section gives us all the data about the Living bodies. Motors and the PIR sensor are being interfaced to the PIC microcontroller. Raspberry Pi 3B+ is used for video processing and sending the processed video to user PC with the help of the Internet or Wi-Fi network. The use of the internet does not have the limitation of range into consideration as we are having the internet access, we can control the robot from anywhere. The images captured by the camera must be processed very fast to provide real-time visualization of location to the user. The Raspberry Pi 3B+ is a credit-card sized computer which has the plugs into our TV and a keyboard. It is a capacity for a little computer, which can be used for projects, and for many of the things that our desktop PC does, like spreadsheets, word processing and games. It also plays the high-definition video.

PIR (Pyroelectric Passive Infrared) sensor here is used for living body detection. A passive infrared sensor is designed to pick up heat radiation of wavelengths in a band nearby 10 microns.

IV. SYSTEM DESIGN

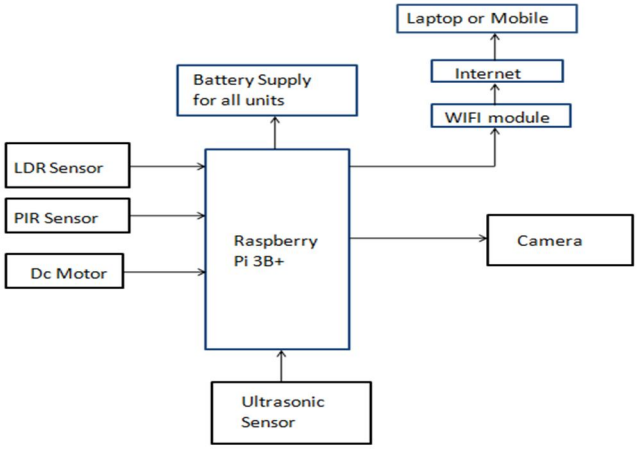


Fig 1: Block Diagram

Above figure represents the layout of the premonitoring system. Here Raspberry pi3B+ is the main component. We attach sensors, camera and wi-fi module to Raspberry pi3B+.Additional feature of mine detection is also being implemented in this application. The metal detecting sensor will upgrade if any metal is detected underground. There can be possibility of danger over there which will be conveyed to us prior.

A. HAAR Algorithm

1) *Input:* Pick pixel value at any *(x,y)* location
2) *Output:* Face detection
3) *Steps:*

a) Pick a pixel location from the image.
pixel value at any *(x,y)* location

b) Sum pixel calculation. Each feature results in a single value which is calculated by subtracting the sum of the white rectangle(s) from the sum of the black rectangle(s). $ii(x,y) = \sum x' \leq x, y' \leq y \; i(x',y')$

c) Haar like features calculate in sub- image.

d) Add the result of the product.

e) Put the resultant value into the new image at the same place where you picked up the pixel location.

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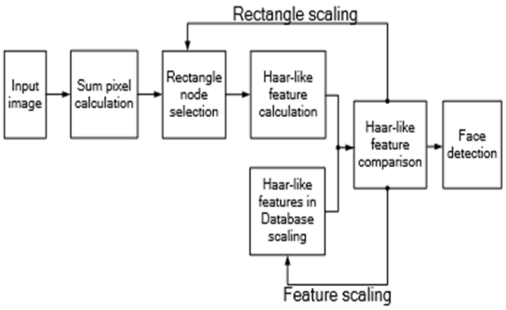


Figure 2: Algorithm Data Flow Diagram

Face detection is a method of detection and recognizing faces from the inputs. Special algorithm has being used for face detection with more efficiency. HAAR algorithm gives the satisfactorily result for effective face detection. Several face detection techniques are available like hidden markov models, neural networks, and optical flow to cascade classifiers. Open CV is the open source computer vision library by Intel. Any picture has numerous pixels within it. The pixels combine to form a image. In HAAR algorithm the initial step is it takes the sum of all pixel calculations. The rectangular borders are placed for required features to be detected. Mainly the effective features of human face are eyebrows, cheek bones, nose, lower lip and upper lip are identified minutely. They are calculated in sense of pixels and if major of result is approving the features, then the face is detected by the algorithm. And the HAAR algorithm approves it as a human face. The learning algorithm, creates the efficient classifiers from set of extracting relevant visual features.

V. RESULT

Comparison of Haar and LBP Performance Results

Parameter	HAAR Algorithm	LBP Algorithm
Results for a Single Object	Haar-like based cascade is better on the standard platform than LBP based cascade.	LBP based cascade is lower on the standard platform than HAAR based cascade.
Accuracy	High detection accuracy	Less detection accuracy
Positive Rate	Low false positive rate	High false positive rate

The result analysis of the application is as below-

Firstly the robot will move automatically. It will able to move in the pits due to good quality of motor wheels. Main result of the application is it will provide the continuous video surveillance of required area. Even the images can be captured from the video surveillance and stored at backup. The video recording and the images will be stored in the cloud as a database backup. The object is being detected in nearby radius of the application.

The underground any metal found will be detected by metal detector under the application. The prior warning will be there for this particular area.

The PIR sensor detects any human found over that area. The percentage is calculated by total faces detected by our algorithm/whole faces present. The algorithm achieved 89.92 % accuracy in face detection.

VI. CONCLUSION

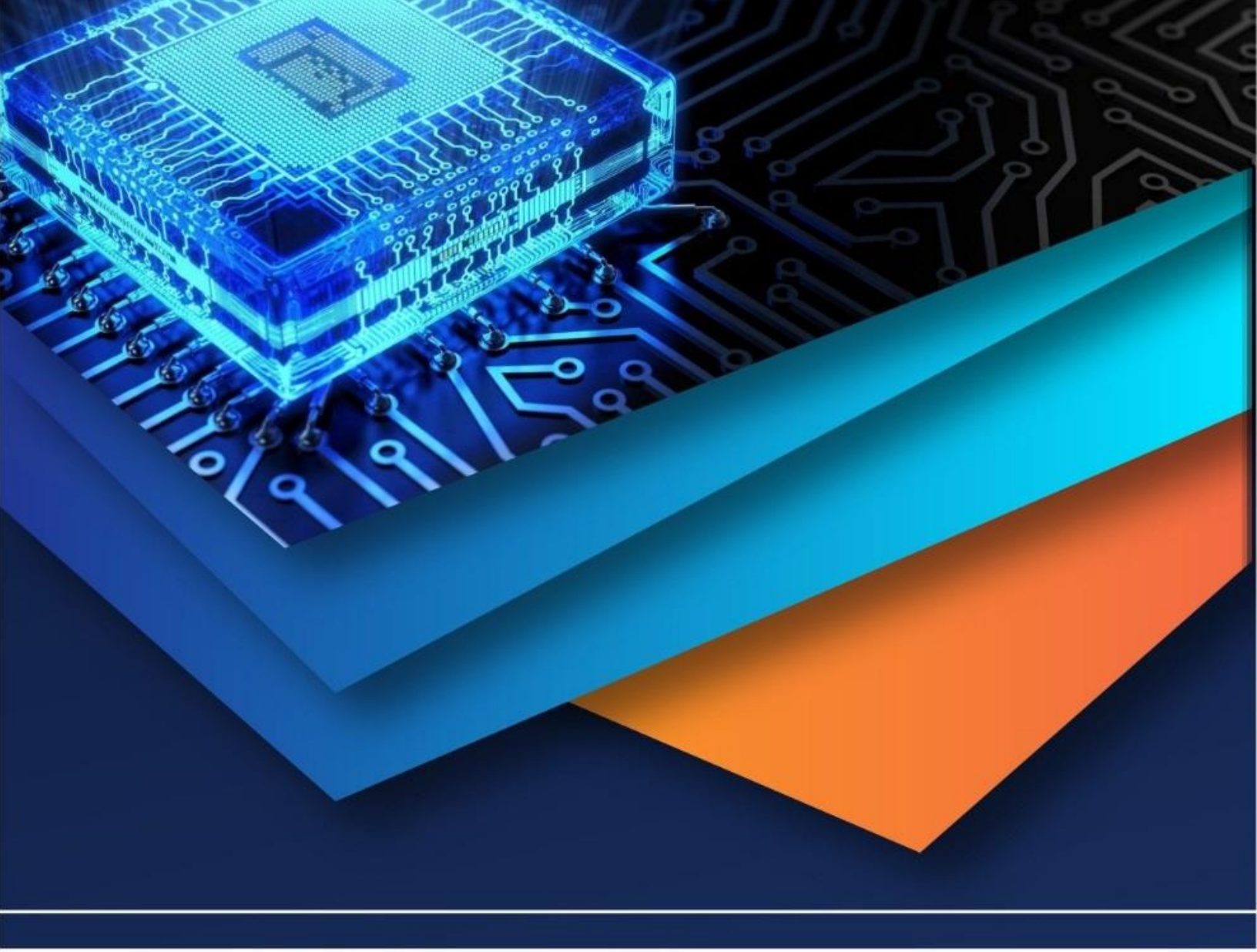
The proposed technology is giving a helping hand to our security forces in detection, monitoring, and intruders. This robot can be used in areas where it is difficult for humans to survive and it can be used as a spy robot. If a robot is within the Wi-Fi range then there is no need of internet also we can control a robot using Wi-Fi as a medium. A system can be used for military application with suitable sensors. This robot is very economical and its possibilities are endless. In the current state the robot provides a platform for further research into the improving capabilities.

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