DESIGN OF MOBILE SURVEILLANCE AND SECURITY BOT FOR HOME SAFETY

[1]D.Chandrakala, [1]K.Adhithiya venkatesh, [1]N.Balaji, [1]B.Mathi bharathi, [1]A.Mohamed Safaaith Hussain,
Easwari Engineering college, Chennai,India. dckala2007@gmail.com

Abstract: Nowadays robots are incorporated in the job which are often difficult for humans and these robots can be used as an effective alternative for humans.Mobile robots have become a significant topic in the security field Several techniques have been introduced to work with mobile robots and security. Most of these methods are not capable of working in low visibility environments and need to be manually controlled by a person all the time. In this smart security system, a mobile robot acts as an e-patrol in both light and dark environments. The design and implementation of mobile robots consist of three subsystems: The obstacle avoidance,image capturing and alarm indication for theft prevention.By means of which bot can be deployed for surveillance in a defined path with specific intervals.

Keywords: Computer vision, Security, IOT, Surveillance,Mobile robot.

1. Introduction

In the Present world, mobile robots have become the most important topic in the security field. Several methods have been introduced to deal with mobile robots and security[11].In order to ensure the safety of humans and their belongings,A Surveillance bot has been designed with several components that are required for monitoring.Generally bot can be used for many applications where it may be inconvenient, dangerous, or to have a human operator present. The bot will have a set of sensors to observe the environment, and will either autonomously make decisions about its behavior or pass the information to a human operator at a different location who will control the vehicle.In order to increase the flexibility of mobile robot usage, recent AGVs are incorporating wireless solutions to communicate with each other as well as with the controller.

2. Proposed Method

The proposed method is a use of mobile surveillance robot [2, 6] to scan the environment and detect the unusual movements in the house.The bot operates on two modes depending on the function and convenience of the user.The operating modes are manual mode and autonomous mode.The mode can be switched via the input from the user.In the manual mode the bot can be manually controlled by using joystick through the mobile web interface.The user can see the real time video of the places through live video streaming [1, 3] in the mobile.This mode can be utilised when the user needs to inspect some places in and around the house while in the autonomous mode the bot operates on its own without any requirement of external needs. In the autonomous mode the bot hover over the specified path by the user initially and scans the environment for intruder.And the camera is mounted on a servo motor for 360 rotation of the camera and also the path is surveyed between specific time interval.This mode comes in handy in night or when there is no one in the house so the bot independently inspect,alert and notifies the user incase of any abnormal circumstances such as intruder detection,intentional hindrance to the path or when the bot is being attacked.The user gets picture of the intruder with the alert.If the user didn't respond to the notification within 10 minutes the bot notifies the police with location and image.There is also option to ignore the alert when the user knows the person detected

3. Hardware Design

In this modern era automation is the endless process. with increase in automation there is a reduce in energy consumption ,it has more benefits & it improves working condition for workers.Nowadays it is good to use automated robots for surveillance rather than using cctv cameras.On using normal cctv cameras, more cameras are required and a separate person (security officer) is required to monitor it continuously but

most of the apartments and villas are using only cameras and not security for monitoring[4, 12] ,as there is no security it is not helping to reduce the theft. It is only helpful to identify the thief after theft. So automated system is a better option for surveillance
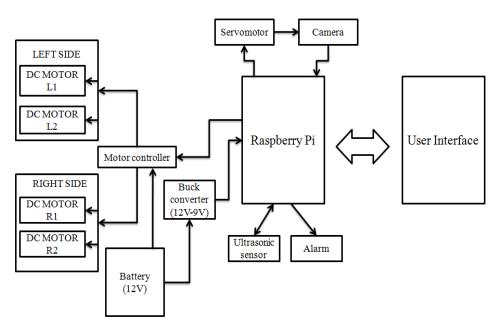

Fig 1. *Block Diagram of Proposed System*

The above figure shows the overall block diagram of the proposed system. As discussed earlier, the security of humans and their belongings [8, 14] is very important.It is necessary to monitor the secured area continuously,So surveillance bot has been developed.It is developed with multiple sensors such as gyroscope in order to prevent the bot from theft and other threats.It has camera for monitoring alarm for protection.The bot is connected through Wi-fi in order to send information to the user about the situation and to monitor it remotely [9] and the user can control the bot using the mobile interface.The bot will alert only when human is detected.Buck converter is connected between battery and Motor controller to supply the voltage as required for the DC motors.

Basically this design has two modes ie manual mode and autonomous mode.The bot is first switched on then it is interfaced with mobile [13] through app/website.Then the mode for working is selected(ie,Manual/Autonomous mode) using a toggle switch.In case of Manual mode the bot is controlled using the controller in the app/website and the video recorded in the camera is streamed live in the same app this mode is used to monitor the children and old people in home this mode [7, 15] does not require some sensors like ultrasonic sensors as it is controlled manually.In case of autonomous mode the bot runs in the predefined path which is given by the user and the camera used is mounted on the servo motor and is continuously rotated in certain angle in both clockwise and anticlockwise direction periodically. Ultrasonic sensor is used for obstacle avoidance,if there is any obstacle in that path the bot stops moving and searches the way to move and moves after it finds the way.While running if it detects any intruder(Person detection) Bot stops moving and captures the image of the person and sends alert to the user with the captured image through mail and the alarm will start ringing after a very small delay.Once the user is intimated He can check the image in the mail and he can switch off the buzzer in the app/web server if that was the known person otherwise the buzz continues and if the user doesn't respond to the alert also the buzzer continues.As the safety of bot is also taken into account it is also connected with gyroscope sensor so if somebody tries to lift the robot or the robot is disturbed or if the position of the robot [5,10] gets altered.Same operation which is done during intruder detection is repeated and the system will be back to normal only after user reset the settings.

4. Software Description

To detect an object, the system opts for a suitable classifier for that object and evaluates it at various locations and scales in a test image. More recent approaches like R-CNN use region proposals. A single network simultaneously predicts multiple bounding boxes and class probabilities for those boxes. YOLO(YOU ONLY LOOK ONCE) trains on full images and directly optimizes detection performance.

This unified model has several benefits over traditional methods of object detection. It is one of the faster methods and also increases the performance. This system divides the input image into grids. If the center of an object falls into a grid cell, that grid cell is responsible for detecting that object. Each grid cell predicts B bounding boxes and confidence scores for those boxes. These confidence scores reflect how confident the model is that the box contains an object and also how accurate it thinks the box is that it predicts. Formally we define confidence as $Pr(Object) * IOU(INTERSECTION\ OVER\ UNION)^{truth}_{pred}$.

Fig 2: Simple Mail Transfer Protocol

After the object has been predicted as a human, bot alerts the user along with the face of the corresponding person. A safety distance factor is also included for the safety of the bot to alert in times of theft situations. User is prompted to take actions regarding the alert which determines the behaviour of the bot.There exists only one set of class probabilities per grid cell, regardless of the number of boxes B. At test time we multiply the conditional class probabilities and the individual box confidence predictions, $Pr(Class_i|Object) * Pr(Object) * IOU^{truth}_{pred} = Pr(Class_i) * IOU^{truth}_{pred}$ (1) which gives us class-specific confidence scores for each box. These scores encode both the probability of that class appearing in the box and how well the predicted box fits the object.
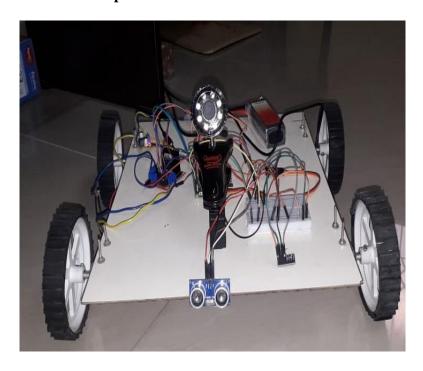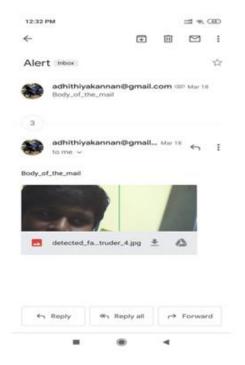
5. Hardware and Software Output
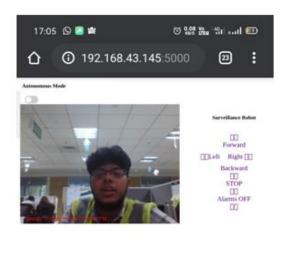

Fig 3. Hardware Prototype

Fig 4. *INTRUDER ALERT MAIL TO THE USER*

Fig 5. Web interface

The typical notification to the user is sent through the mail.Multiple users can also be notified through the mail with the image of the intruder.The user is able to ignore the notification and turn off the alarm if the intruder is the known person.The user can also toggle between manual and autonomous mode through the web interface.

6. Conclusion

In this paper,We proposed and developed an efficient and effective way of monitoring and inspecting the defined environment.Previous generation of surveillance bot does not have any autonomous capabilities and does not have sensors like gyroscope and ultrasonic sensor for the safety of the robot .By having both manual control and autonomous capability the robot can be accessed for various security related applications. The user friendly web interface makes it easier to operate from any part of the world. Further this robot can be altered with a specific set of sensors depending upon the terrain and function to be carried.The system has been tested and implemented practically. In future using port forwarding techniques it can be made an universally accessed robot. Later the robot can be accessed using a website by connecting it to an external web server.

7. References

[1] Muhammad Hamza, M Atique-ur-Rehman, Hamza Shafqat, Subhan Bin Khalid's,"CGI SCRIPT AND MJPG VIDEO STREAMER BASED SURVEILLANCE ROBOT USING RASPBERRY PI" published in 16th International Bhurban Conference on Applied Sciences & Technology (IBCAST) Islamabad, Pakistan, 8th – 12th January, 2019

[2] Mayuri Sonkusare, Akshata Raut, Dhanashree Tamhane, Deepali Palase,Amit Maurya "Surveillance Robot with Human Detection published in the 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT 2018)

[3] Diksha Singh,Pooja Zaware and Dr Anil Nandgaonkar "Wi-Fi Surveillance Bot with Real Time Audio & Video Streaming Through Android Mobile" published in IEEE Transactions on International Conference On Recent Trends in Electronics Information & Communication Technology (RTEICT) in 2017.

[4] Meghana S, Nikhil Teja V, Raghuveer Murali, Sanjana S, Vidhya R Khurram J Mohammed's" DESIGN AND IMPLEMENTATION OF SURVEILLANCE ROBOT FOR OUTDOOR SECURITY" published in 2nd IEEE International Conference.On Recent Trends In Electronics Information & Communication Technology, May 19-20, 2017, India.

[5] Chirag B,Manjunath A.E,Badrinath KB "An Intelligent Cloud based Cost Effective Surveillance Robot" published in IEEE 2014.

[6] Dr. Thair Ali Salh, Mustafa Zuhaer Nayef's "Intelligent Surveillance Robot " published in The First International Conference of Electrical, Communication, Computer, Power and Control Engineering ICECCPCE'13!December17-18, 2013.

[7] Xinyu Wu, Haitao Gong, Pei Chen, Zhong Zhi and Yangsheng Xu "Intelligent household surveillance robot "published in IEEE Transactions on International Conference on Robotics and Biomimetics in 2009.

[8] Mohammed Faisal, Hassan Mathkour, Mansour Alsulaiman's "Smart Mobile Robot for Security of Low Visibility Environment" published in Centre Of Smart Robotics Research (CSRR), College of Computer & Information Sciences (CCIS) King Saud University Riyadh, Saudi Arabia

[9] Aditya Sundaram, Monel Gupta,Vinod Rathod,K Chandrasekaran "Remote Surveillance Robot System- A Robust Framework using Cloud" Published in 2015 IEEE International Symposium on Nanoelectronic and Information Systems

[10] Ki Sang Hwang ; Kyu Jin Park ; Do Hyun Kim ; Sung-Soo Kim ; Sung Ho Park "Development of a Mobile Surveillance Robot" Published in International Conference on Control, Automation and Systems 2007

[11] Daniela D'Auria,Fabio Persia,Fabio Bettini,Sven Helmer,Bruno Siciliano "SARRI: a SmArt Rapiro Robot Integrating a framework for automatic high-level surveillance event detection" Published in 2018 Second IEEE International Conference on Robotic Computing.

[12] Kyunghoon Kim, Soonil Bae, and Kwanghak Huh "Intelligent surveillance and security robot systems" Published in 2010 IEEE Workshop on Advanced Robotics and its Social Impacts

[13] Rafael G. N. da Silva, Almir K. Junior "Indoor surveillance robotic system using an autonomous mobile robot" Published in 2015 CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON)

[14] Ashish U. Bokade ; V. R. Ratnaparkhe "Video Surveillance Robot Control using Smartphone and Raspberry Pi" Published in International Conference on Communication and Signal Processing, April 6-8, 2016, India

[15] Tharindu Dharmasena ; Pradeep Abeygunawardhana "Design and Implementation of an Autonomous Indoor Surveillance Robot based on Raspberry Pi" Published in 2019 International Conference on Advancements in Computing (ICAC) December 5-6, 2019. Malabe, Sri Lanka.