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Surveillance Rover Based on Real Time Object Recognition

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ABSTRACT

In the past few years there have been plenty of technical advancements in surveillance, by the introduction of types of closed loop cameras. These have assisted in solving crime scenes and yet, the rate has not reduced due to the immovability of the surveillance equipment. In any hostage situations security cameras are the first to be targeted by the outlaws to protect their identity. therefore, the need for the development of mobile surveillance equipment is high. Residential areas, government organizations, commercial spaces, schools and hospitals, industries, banking and other challenging indoor and outdoor environments require surveillance systems. This project proposes a rover which can be controlled through the internet and can be used for surveillance applications. Raspberry Pi 3 B+ is used as the brain of the system and the module is also capable of performing Object Recognition using the YOLO.V3 algorithm which is based on deep learning. The rover can be controlled through an android application which communicates with the Raspberry Pi on the Rover and gets the job done. VNC viewer is used to have an access to the Raspbian OS of Raspberry Pi to make changes in its functioning.

Keywords: *S*urveillance. Raspberry Pi 3 B+, YOLO.V3, deep learning, Raspbian OS.

1. INTRODUCTION

In the existing scenario almost, all modern application employs image processing techniques. All the application from object recognition or object detection to basic operation like filtering, compression and enhancement comes into picture when we think of image processing domain. Thus, image processing is undoubtedly one of the most employed and popular domains [1-3].

This proposed system deals with the design of a Rover module which can be used for surveillance application and can perform object recognition in real time. These papers and proposes implantation of rover with Raspberry Pi for object detection [4]. The rover module is programmed so as to live stream the video which it captures with the help of a camera through internet and the rover is controlled through an android application which is explained in paper [5-8].

Surveillance is mandatory in many areas to ensure the safety or the monitor the functioning, preventing crimes, collection of evidence, avoid any intruders etc which is referred from paper. This project proposes a rover that can be used for such application which can be controlled through the internet and respective area can be monitored without any human intervention [9-11]. It is also programmed to perform Object recognition based on deep learning techniques and can recognize objects that it captures on the video and can be programmed to send any alert if some particular object is detected of the objects that the rover encounters in its path [12]. This paper gives us knowledge about deep learning and propose efficient method for object detection. Object recognition is gaining importance in the field of image processing ever since its being implemented and is employed in almost all high –end application like ADAS (Advance Driver Assistance System), Manufacturing application in industries, Military applications, Designing machines, Surveillance and monitoring Applications etc [13-17]. For example, Tesla Auto Pilot is considered to be the best implementation of ADAS where the vehicle can drive to the required destination with no human interference provided the ideal conditions [18-21].

Object Recognition or Object Detection is the process of identifying different objects in an image or a video based on the features (inputs) that has been fed in the prior and trained accordingly. YOLO Object Recognition Algorithm is used for the purpose of the object recognition and it is not a region-based algorithm like ResNet, R-CNN etc. The architecture of YOLO is more like that of a F-CNN. YOLO trains on complete image while training and is ideal for hardware with low processing power and is a bit faster than R-CNN [21-24].

2. THE PROPOSED SYSTEM

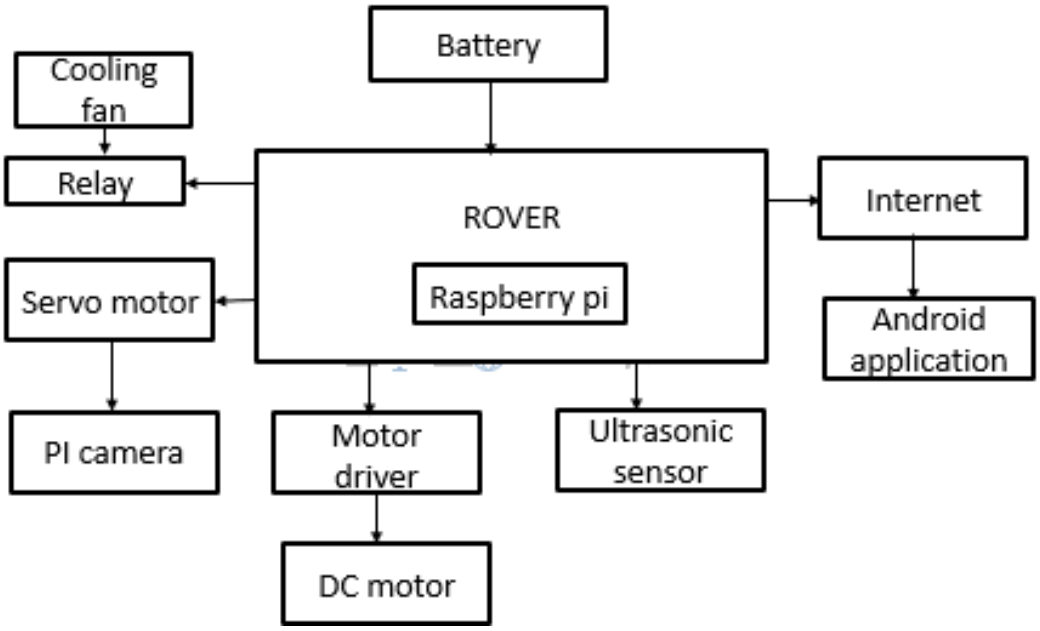

Figure -1 Block Diagram of proposed system

The system consists of two the Rover and the user end [25]. The user end is the VNC viewer from which the Raspbian operating system of the Raspberry Pi is remotely shared to the PC/Mobile of the user through which any changes can be modified. For controlling the movement and reading the data from the Raspberry Pi Blynk android application id implemented and the communication between the application and Pi is achieved via local Blynk Server [26]. The rover end consists of the Raspberry Pi, Pi Camera, L293D motor driver IC, Relay Module, 1,2 Ah Battery 0f 12V, servo motor, two Dc motors, HC-SR05 Ultra Sonic sensor and four wheels which aid in the movement of the Pi. The Dc motors are connected to the Raspberry Pi via the motor driver which is generally an H-Bridge circuit and aids in achieving the speed and direction control of the two 12V Dc motors to which the wheels are attached [27]. The GPIO pins of the Pi are configured to output a high pulse to the L293 which aids in the movement of the rover. The Pi is connected to the Raspberry Pi through the Camera Serial Interface and a servo motor is attached to the Pi cam for rotation. The Raspberry Pi Cam is preferred over the Webcam so as to bring the Graphic Processing Unit of the Raspberry Pi into picture for video capture and object recognition and to achieve higher frame rates. A 12V battery which can pump up exactly 1.2 Ampere Current for an Hour is implemented to power up the Rover[28-29].

The relay module is a switching circuit of 4 channels which is used for making and breaking the circuit and the IP pins of the module are connected to the GPIO of the Raspberry Pi. A 12V cooling fan is provided for the Raspberry Pi to ais the performance and to prevent thermal throttling [30-35]. Moreover, the Raspberry Pi has only 1 Gb of LPDDR2 Ram and running such a big script for all the control, sensor data and object recognition will surely reduce its performance so it's better to have some heat dissipation system. HC-SR05 Ultra Sonic sensor is placed in front of the rover to detect the objects that the Raspberry Pi may encounter and to measure the distance if the object is within its range. It emits ultra-sonic waves of high frequency and when they touch any object they are reflected back and detected by the sensor [36-43].

3. RESULTS AND DISCUSSION

The whole assembly is based on a metal slab(plate) to which holes are drilled through out to fit screws. Four wheels are attached to the sides of the plate and the two rear wheels are connected to the 12V DC motors for movement. A cardboard of the same size as that of the metal slab is placed and fixed on top of the slab which aids in fitting of the components. The cardboard is used to provide isolation between components and the metal plate to avoid any losses and as metal plate is not ideal to fit any electronics on top of it. The Raspberry Pi, Motor Driver Modules, Relay modules, Battery are fitted on top of the Cardboard and the connections are given. The Pi Camera is fitted to a servo motor which aids in the rotation of the camera and is fitted at the front of the Rover.HC-SR05 Ultrasonic Sensor is attached at the front of the Rover for getting the job of obstacle detection done.

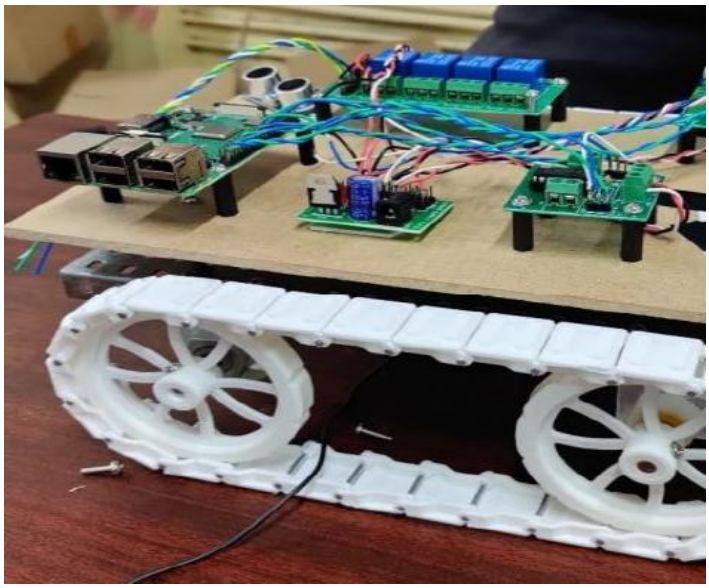

Figure -2 Rover Module

The results of the object detection are as follows:

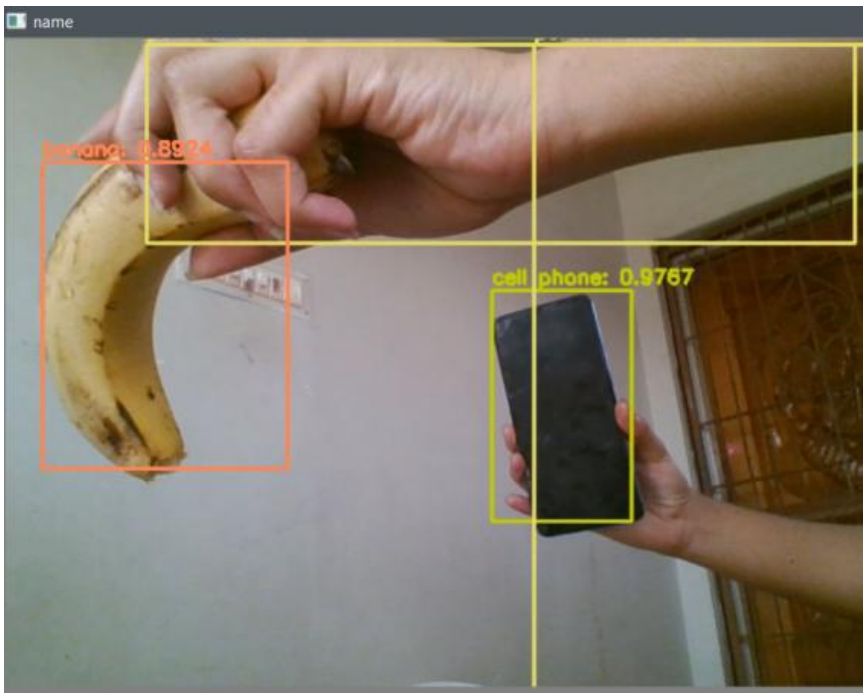

Figure-3 Demonstration of object recognition

In this project a surveillance rover module which can perform multiple tasks such as object recognition, video streaming and data collection from multiple sensors is developed. This project proposes a low-cost module which can perform complex tasks such as the object detection with minimum resources. Yolo Object Recognition algorithm which is based on deep learning is implemented in this project. The communication between the user and the rover module is achieved through internet via an android application. This module can be implemented for a variety of surveillance applications. It can be programmed to move on its own through a defined path and alert the user if any person (specific object) is found. The object recognition model can be trained to detect as many objects as we want by feeding the images of that particular object as input and training it. The system is flexible enough to allow any changes the user wants to make and can be programmed accordingly.

REFERENCES

[1] J. Redmon, S. Divvala, R. Girshick and A. Farhadi, "You Only Look Once: Unified, Real-Time Object Detection," IEEE Conference on Computer Vision and Pattern Recognition (CVPR), (2016).

[2] Babu, N.V., 2014. Design and performance analysis of clustering mechanisms for wireless sensor networks.

[3] Vu, D.L., Nguyen, T.K., Nguyen, T.V., Nguyen, T.N., Massacci, F. and Phung, P.H., 2020. HIT4Mal: Hybrid image transformation for malware classification. Transactions on Emerging Telecommunications Technologies, 31(11), p.e3789.

[4] Geetha Priya. S, N. Duraimurugan, S.P. Chokkalingam, "Real-time object detection with Yolo", International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8, Issue-3S, February 2019

[5] Prabu, S., Balamurugan, V. and Vengatesan, K., 2019. Design of cognitive image filters for suppression of noise level in medical images. Measurement, 141, pp.296-301.

[6] Muhammad, L.J., Algehyne, E.A., Usman, S.S., Ahmad, A., Chakraborty, C. and Mohammed, I.A., 2021. Supervised machine learning models for prediction of COVID-19 infection using epidemiology dataset. SN computer science, 2(1), pp.1-13.

W. Yang and Z. Jiachun, "Real-time face detection based on YOLO," in 2018 1st IEEE International Conference on Knowledge Innovation and Invention (ICKII), 2018.

[7] K G Shreyas Dixit, Mahima Girish Chadaga, Sinchana S Savalgimath, G RagavendraRakshith, Naveen Kumar M R, "Evaluation and Evolution of Object Detection Techniques YOLO and R-CNN", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8, Issue-2S3, July 2019

[8] Mohammad JavadShafiee, Brendan Chywl, Francis Li, Alexander Wong, "Fast YOLO: A Fast You Only Look Once System for Real-time Embedded Object Detection in Video", arXiv:1709.05943 (2019).

[9] Dwivedi, R., Dey, S., Chakraborty, C. and Tiwari, S., 2021. Grape disease detection network based on multi-task learning and attention features. IEEE Sensors Journal.

[10] Lingappa, H., Suresh, H. and Manvi, S., 2018. Medical image segmentation based on extreme learning machine algorithm in kernel fuzzy c-means using artificial bee colony method. Int. J. Intell. Eng. Syst, 11, pp.128-136.

[11] Le, Ngoc Tuyen, Jing-Wein Wang, Duc Huy Le, Chih-Chiang Wang, and Tu N. Nguyen. "Fingerprint enhancement based on tensor of wavelet subbands for classification." *IEEE Access* 8 (2020): 6602-6615.

[12] Nayak, Jithendra PR, K. Anitha, B. D. Parameshachari, Reshma Banu, and P. Rashmi. "PCB Fault detection using Image processing." In *IOP Conference Series: Materials Science and Engineering*, vol. 225, no. 1, p. 012244. IOP Publishing, 2017.

[13] Nguyen, Tu N., Bing-Hong Liu, Nam P. Nguyen, and Jung-Te Chou. "Cyber security of smart grid: attacks and defenses." In *ICC 2020-2020 IEEE International Conference on Communications (ICC)*, pp. 1-6. IEEE, 2020.

[14] Babu, R.G., Maheswari, K.U., Zarro, C., Parameshachari, B.D. and Ullo, S.L., 2020. Land-Use and Land-Cover Classification Using a Human Group-Based Particle Swarm Optimization Algorithm with an LSTM Classifier on Hybrid Pre-Processing Remote-Sensing Images. Remote Sensing, 12(24), p.4135.

[15] Nguyen, Ngoc-Tu, Bing-Hong Liu, Shao-I. Chu, and Hao-Zhe Weng. "Challenges, designs, and performances of a distributed algorithm for minimum-latency of data-aggregation in multi-channel WSNs." *IEEE Transactions on Network and Service Management* 16, no. 1 (2018): 192-205.

[16] Rajendran, Ganesh B., Uma M. Kumarasamy, Chiara Zarro, Parameshachari B. Divakarachari, and Silvia L. Ullo. "Land-use and land-cover classification using a human group-based particle swarm optimization algorithm with an LSTM Classifier on hybrid pre-processing remote-sensing images." *Remote Sensing* 12, no. 24 (2020): 4135.

[17] Redmon, J., & Farhadi, A. (2016). YOLO9000: better, faster, stronger. arXiv preprint arXiv:1612.08242.

[18] Nguyen, Ngoc-Tu, Bing-Hong Liu, Van-Trung Pham, and Ting-Yan Liou. "An efficient minimum-latency collision-free scheduling algorithm for data aggregation in wireless sensor networks." *IEEE Systems Journal* 12, no. 3 (2017): 2214-2225.

[19] Rajendrakumar, Shiny, V. K. Parvati, B. D. Parameshachari, KM Sunjiv Soyjaudah, and Reshma Banu. "An intelligent report generator for efficient farming." In *2017 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT)*, pp. 1-5. IEEE, 2017.

[20] Nguyen, Ngoc-Tu, and Bing-Hong Liu. "The mobile sensor deployment problem and the target coverage problem in mobile wireless sensor networks are NP-hard." *IEEE Systems Journal* 13, no. 2 (2018): 1312-1315.

[21] Manjanaik, N., B. D. Parameshachari, S. N. Hanumanthappa, and Reshma Banu. "Intra Frame Coding In Advanced Video Coding Standard (H. 264) to Obtain Consistent PSNR and Reduce Bit

Rate for Diagonal Down Left Mode Using Gaussian Pulse." In *IOP Conference Series: Materials Science and Engineering*, vol. 225, no. 1, p. 012209. IOP Publishing, 2017.

[22] Ngo, T.D., Bui, T.T., Pham, T.M., Thai, H.T., Nguyen, G.L. and Nguyen, T.N., 2021. Image deconvolution for optical small satellite with deep learning and real-time GPU acceleration. Journal of Real-Time Image Processing, pp.1-14.

[23] Subramani, Prabu, K. Srinivas, R. Sujatha, and B. D. Parameshachari. "Prediction of muscular paralysis disease based on hybrid feature extraction with machine learning technique for COVID-19 and post-COVID-19 patients." *Personal and Ubiquitous Computing* (2021): 1-14.

[24] Rajendrakumar, Shiny, and V. K. Parvati. "Automation of irrigation system through embedded computing technology." In *Proceedings of the 3rd International Conference on Cryptography, Security and Privacy*, pp. 289-293. 2019.

[25] Nguyen, Tu N., Bing-Hong Liu, and Shih-Yuan Wang. "On new approaches of maximum weighted target coverage and sensor connectivity: Hardness and approximation." *IEEE Transactions on Network Science and Engineering* 7, no. 3 (2019): 1736-1751.

[26] Bhuvaneswary, N., S. Prabu, K. Tamilselvan, and K. G. Parthiban. "Efficient Implementation of Multiply Accumulate Operation Unit Using an Interlaced Partition Multiplier." *Journal of Computational and Theoretical Nanoscience* 18, no. 4 (2021): 1321-1326.

[27] Parameshachari, B.D., Panduranga, H.T. and liberata Ullo, S., 2020, September. Analysis and Computation of Encryption Technique to Enhance Security of Medical Images. In IOP Conference Series: Materials Science and Engineering (Vol. 925, No. 1, p. 012028). IOP Publishing.

[28] Rajendrakumar, Shiny, V. K. Parvati, B. D. Parameshachari, KM Sunjiv Soyjaudah, and Reshma Banu. "An intelligent report generator for efficient farming." In *2017 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT)*, pp. 1-5. IEEE, 2017.

[29] Nguyen, Ngoc-Tu, Ming C. Leu, and Xiaoqing Frank Liu. "RTEthernet: Real-time communication for manufacturing cyberphysical systems." *Transactions on Emerging Telecommunications Technologies* 29, no. 7 (2018): e3433.

[30] P. Ren, W. Fang, and S. Djahel, “A novel YOLO-Based realtime people counting approach,” in 2017 International Smart Cities Conference (ISC2), 2017, pp. 1–2

[31] Ankit Sachan, “Zero to Hero: Guide to Object Detection using Deep Learning: Faster R-CNN, YOLO, SSD,” CV-Tricks.com, 2018.

[32] Hemalatha, K. L., SUNILKUMAR MANVI, and HN SURESH. "ADAPTIVE WEIGHTED-COVARIANCE REGULARIZED KERNEL FUZZY C MEANS ALGORITHM FOR MEDICAL

IMAGE SEGMENTATION." *Journal of Theoretical & Applied Information Technology* 95, no. 14 (2017).

[33] Bhuvaneswary, N., S. Prabu, S. Karthikeyan, R. Kathirvel, and T. Saraswathi. "Low Power Reversible Parallel and Serial Binary Adder/Subtractor." *Further Advances in Internet of Things in Biomedical and Cyber Physical Systems* (2021): 151.

[34] Hemalatha, K. L., S. M. Ashitha, and S. R. Meghana. "Design and implementation of modified FCM in the detection of brain tumor." *Int. J. Adv. Sci. Res. Eng* 3, no. 4 (2017): 2850-2858.
[35] K. Yu, L. Tan, L. Lin, X. Cheng, Z. Yi and T. Sato, "Deep-Learning-Empowered Breast Cancer Auxiliary Diagnosis for 5GB Remote E-Health," IEEE Wireless Communications, vol. 28, no. 3, pp. 54-61, June 2021, doi: 10.1109/MWC.001.2000374.
[36] K. Yu, L. Tan, S. Mumtaz, S. Al-Rubaye, A. Al-Dulaimi, A. K. Bashir, F. A. Khan, "Securing Critical Infrastructures: Deep Learning-based Threat Detection in the IIoT", IEEE Communications Magazine, 2021.
[37] L. Zhen, A. K. Bashir, K. Yu, Y. D. Al-Otaibi, C. H. Foh, and P. Xiao, "Energy-Efficient Random Access for LEO Satellite-Assisted 6G Internet of Remote Things", IEEE Internet of Things Journal, doi: 10.1109/JIOT.2020.3030856.
[38] K. Yu, L. Tan, M. Aloqaily, H. Yang, and Y. Jararweh, "Blockchain-Enhanced Data Sharing with Traceable and Direct Revocation in IIoT", IEEE Transactions on Industrial Informatics, doi: 10.1109/TII.2021.3049141.
[39] K. Yu, L. Lin, M. Alazab, L. Tan, B. Gu, "Deep Learning-Based Traffic Safety Solution for a Mixture of Autonomous and Manual Vehicles in a 5G-Enabled Intelligent Transportation System", IEEE Transactions on Intelligent Transportation Systems, doi: 10.1109/TITS.2020.3042504.
[40] Z. Guo, Y. Shen, A. K. Bashir, M. Imran, N. Kumar, D. Zhang and K. Yu, "Robust Spammer Detection Using Collaborative Neural Network in Internet of Thing Applications", IEEE Internet of Things Journal, vol. 8, no. 12, pp. 9549-9558, 15 June15, 2021, doi: 10.1109/JIOT.2020.3003802.
[41] C. Feng, K. Yu, M. Aloqaily, M. Alazab, Z. Lv and S. Mumtaz, "Attribute-Based Encryption with Parallel Outsourced Decryption for Edge Intelligent IoV," IEEE Transactions on Vehicular Technology, vol. 69, no. 11, pp. 13784-13795, Nov. 2020, doi: 10.1109/TVT.2020.3027568.
[42] S. Chen, L. Zhang, Y. Tang, C. Shen, R. Kumar, K. Yu, U. Tariq, and A. K. Bashir, "Indoor Temperature Monitoring Using Wireless Sensor Networks: A SMAC Application in Smart Cities", Sustainable Cities and Society, vol. 61, p. 102333, July 2020.
[43] W. Zeng, Z. Guo, Y. Shen, A. K. Bashir, K. Yu, Y. D. Al-Otaibi, and X. Gao, "Data-Driven Management for Fuzzy Sewage Treatment Processes Using Hybrid Neural Computing", Neural Computing and Applications, https://doi.org/10.1007/s00521-020-05655-3.