iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** IV **Month of publication:** April 2020

DOI: http://doi.org/10.22214/ijraset.2020.4033

Smart Classroom using Object Detection

Ravi Patel[1], Vishva Patel[2], Mohit Radadiya[3], Hardik Patel[4], Dr. Chirag Patel[5]
[1, 2, 3, 4]*B.Tech. Student, Dept. of Computer Science and Engineering, Parul University, Waghodia Road, Limda, Vadodara, INDIA*
[5]*Dr. (Associate Professor), Dept. of Computer Science and Engineering, Parul University, Waghodia Road, Limda, Vadodara, INDIA*

Abstract: We have transitioned in an era from traditional teaching equipment's using (Blackboards, chalk) to technology equipped (projector, computer, surveillance cameras) classroom known to us as smart classrooms. But are they really Smart Classrooms? These equipment's are powered by electricity and it's important to switch off the appliances after use, but we tend to forget due to laziness or dependency on peon for this task, this causes a very huge wastage of electricity. Thus, our project aims to solve this problem once and for all by automatic switching on & off the appliances of the classrooms when there is no one in the classroom. We aim to achieve this solution using a mixture of Machine Learning (Image processing, Convolutional Neural Network) for detection of human presence in the classroom, then IOT (Raspberry pi, Relay, Generic Camera) to switch the appliances on or off.
Keywords: Deep Learning, Machine Learning, IOT, Raspberry pi, YOLO, PI Camera, CNN.

I. INTRODUCTION

It is generally observed that students tend to forget to switch off the appliances of the classroom after the class. As a result, a huge amount of electricity is wasted. This issue of wastage of electricity in the classrooms due to not switching off the appliances after use causes a huge loss of electricity and money to the institution. Tough there exists various solutions to smart classroom there is always research on as to increase reliability, accuracy, agility to the changes as technology is evolving at an exponential rate. I rose a question to myself as what is called smart? The answer that popped in my head was "Intelligence to make decisions based on the situations", our current classrooms seem to lack this ability. The currently claimed "Smart Classrooms" mostly, have only sensors distributed across the classroom connected to centralized embedded hardware. This makes the whole project specific to certain task, hardwired, non-agile and static. There is more hardware than software in traditional methods. By taking all this into consideration we ended up with a solution that is more scalable, agile, very less hardware and more software and robust. By using Machine Learning algorithms and IOT (Internet of Things) we provided equipped classrooms the decision making capability based on situations. Most classrooms nowadays, are equipped with cameras, thus using human detection and tracking inside the classroom, based on the location of student(s), switching on/off the appliance(s) in that location is achieved, moreover switching off all the appliances when there is no human presence in real time. Section II evaluates various algorithms for human detection and the link to hardware. Section III describes the proposed methodology of the project. Section IV describes the working and observations. Section V concludes the work with future directions.

II. LITERATURE REVIEW

There are various object detection algorithms available in the literature with varied performance, accuracies, compatible dataset. Object detection is achieved based on various Neural Networks. There are various techniques of object detection discussed here based on CNN (Convolutional Neural Network) namely R-CNN, Fast R-CNN and YOLO. There is also need for object tracking in real time thus, techniques such as frames background subtraction. In deep learning, a convolutional neural networks are a class of deep neural networks, commonly applied to visual imagery [1]. R-CNN, Fast R-CNN, Faster R-CNN and YOLO are based on CNN neural network but have different number of layers, accuracy, and performance [1]. Deep learning used by the network has been constantly improving, in addition to the changes in the network structure, the more is to do some tune based on the original network or apply some trick to make the network performance to enhance.

A. R-CNN

Paper on (Application of Deep Learning in Object Detection), one of the most noteworthy points of this papers is that the CNN is applied to extract the feature vector and second is to propose a way to effectively train large CNNs. It's supervised learning pre-training on large dataset such as ILSVRC [1], and then do some fine-tuning training in a specific range on a small dataset such as PASCAL VOC [2].

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue IV Apr 2020- Available at www.ijraset.com

B. Fast R-CNN

For the shortcomings of R-CNN and SPP-Net [1], Fast R-CNN has higher detection quality (mAP); compare to R-CNN, Fast R-CNN is 9 times faster (training) and speed for testing is 213 times faster. Fast R-CNN training stage is 3 times faster than SPP-net and the speed for test is 10 times faster, the accuracy rate also has a certain increase.

C. Faster R-CNN

The emergence of SPP-net and Fast R-CNN has greatly reduced the running time of the object detection network. However, the time they take for the regional proposal method is too long. Faster R-CNN [1] presents a solution to this problem by converting traditional practices (such as Selective Search, SS) to use a deep network to compute a proposal box (such as Region Proposal Network, RPN).

D. YOLO (You Only Look Once)

In the paper (You Only Look Once, unified real-time object detection) researchers decided to make system to detect Object based on You Only Look Once (YOLO) technique [3]. YOLO model process image in real time at 45 frames per second (fps). A smaller version of the network Fast YOLO process an astounding 155 fps [3]. YOLO learns very general representation of object. It outperforms other detection methods such as R-CNN. It resizes the input image or frames (for object detection in video) into 416 X 416 and runs a single convolutional network on the image/ frames thresholds the resulting detection by the model's confidence. The system divides the input images into 5 X 5 grid. If the centre 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 score 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 it that it predicts formally we define confidence. If no object exists in that cell, then confidence score should be zero. Otherwise we want the confidence score predicted box and the ground unit. These predictions are encoded as an **S X S X (B * 5 + C)** tensors. Where B is Bounding Box and C is class probabilities [3]. YOLO network is designed based on the backbone of Google Net [4].

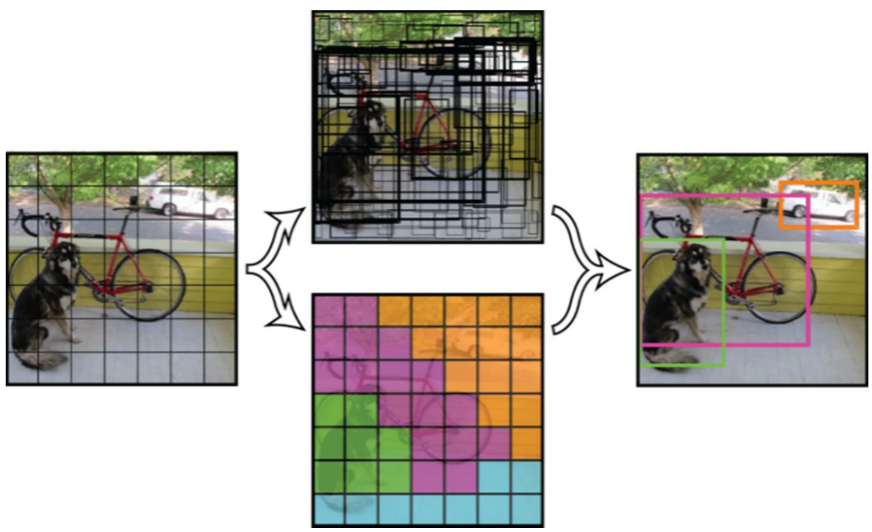


Fig 1. YOLO Object Detection Sample [3]

In this paper, our experiment chooses the latest version of YOLO at this time YOLO v3 has following configuration, it is 4x faster. Moreover, one can simply trade by changing size of the model. It processes images at 46 FPS and has a mAP of 41.2% on COCO [1] test-dev [5]. It uses multi-scale predictions. In this paper we perform real time human detection using raspberry pi and its Picamera. This model gives an overview of Raspberry Pi ARM CortexA53 based processor board. The main features of Raspberry Pi are Broadcom BCM2837 ARM Cortex-A53 processors (900MHz), 1GB RAM, on board USB 2.0 ports [6]. Providing a wide range of processors based on a common architecture that delivers high performance and cost efficiency. As the experiment performs the whole frame processing which s software intensive task thus, Raspberry pi is used.

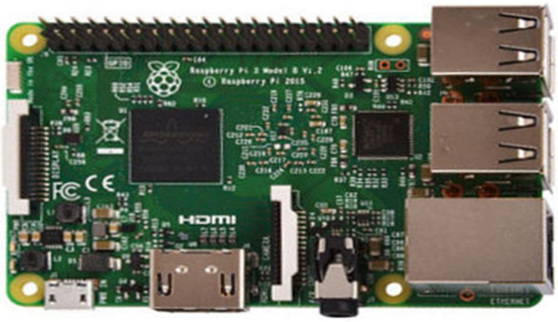


Fig 2. Raspberry pi Model B

III. PROPOSED METHODOLOGY

In the current scenario sensors are embedded on top of all the equipment that are to be operated. An embedded system like Arduino or ESP device is connected to all the sensors. In the code all the setup inputs are declared, and according to the input from the sensors the particular equipment is turned on and off using relays to alter the power supply. This methodology is static, easy and low maintenance but is assigned to perform a specific task of switching on/off but is not agile, scalable and robust. The Fig 3. Depicts the proposed methodology.

A. Raspberry pi Camera Surveillance

The generic camera of the raspberry pi which has a frame rate of 30 fps in high definition will start a video surveillance, at the original release of the camera, - two modes are provided: a stills capture mode, which offers the full resolution of the sensor (2592×1944), and a 1080p video mode (1920x1080p) - will send a video frames to the Opencv's functions for the adjustment of the frame, i.e. to scale, change resolution to 416 x 416 which is the input for the YOLO algorithm for the detection and then converting into numpy array.

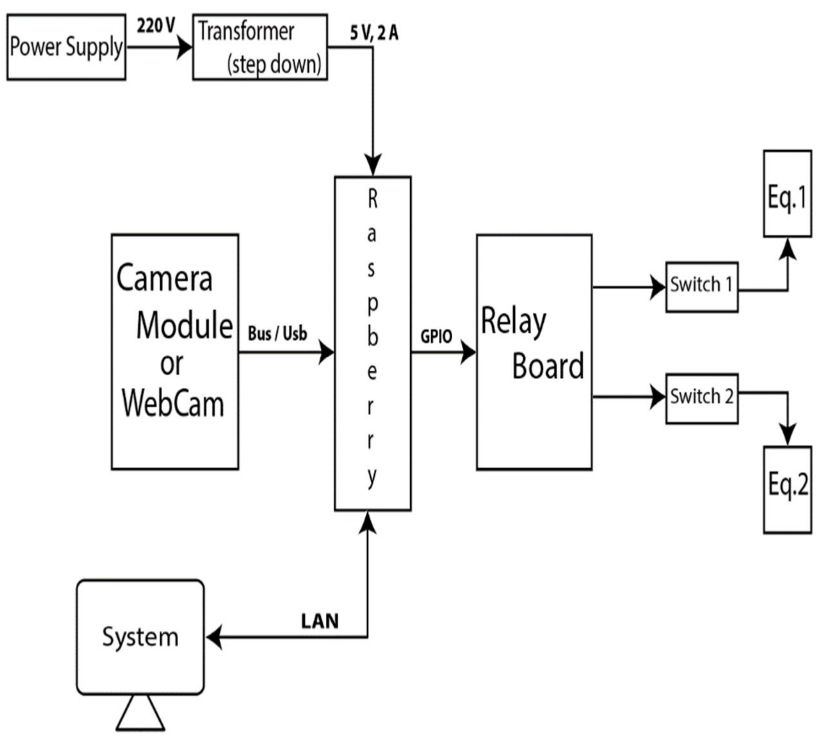


Fig 3. Proposed Methodology for Smart Classroom

B. Human Detection and Tracking Algorithm

The dataset which we are used to identify human presence is COCO dataset which is compatible with YOLO algorithm. YOLO will detect human presence using 416 X 416 pixel frames from the video surveillance and uses the background elimination techniques [7] to detach foreground from the background and then uses the object detection model to track the object (human). According to the model of classroom designed for this research there are two divisions of the classroom namely Left and Right. If the human presence is detected in the Left region, then only the GPIO pins [6] mapped with the appliances on the left side are triggered and same for the right side.

C. Actuation

The raspberry pi then pivots the power supply to the 5v relay with the mapped id (GPIO Pin) of the appliance and it switches the appliance on or off. When there is no human detection inside the classroom the algorithm returns ‘LOW’ to all the GPIO Pins of that classroom thus, it automatically switches off the appliances. The appliances used in this research are 5v DC Motor (Fan) and LED (Tube light).

IV. RESULTS AND OBSERVATIONS

Experiments carried out on all the four combinations by using dummy human shaped toys on Only Left side, Left and Right side, Only Right side, No Human Presence. According to observation the time taken to process a frame is 36sec in Picamera and 37 sec in web cam with frame rate of around 40FPS which is good as there is no hard real time requirement to process the frames faster. After tweaking the threshold value from 0.1 to 0.5 the results were the same. The detection fades out in low light and dark conditions as YOLO is unable to detect objects in Dark mode unless night vision camera is used. The observations remain the same for the night vision camera. Fig 4. Shows the model and Fig 5. Fig 6. Shows the results.

Fig 4. Model Setup

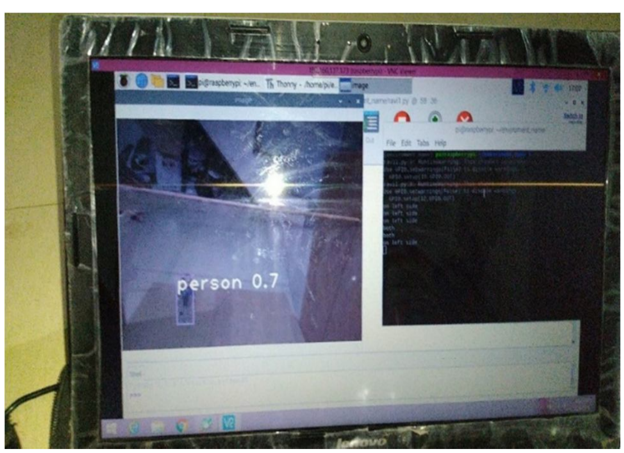


Fig 5. Model Working Left Side

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue IV Apr 2020- Available at www.ijraset.com

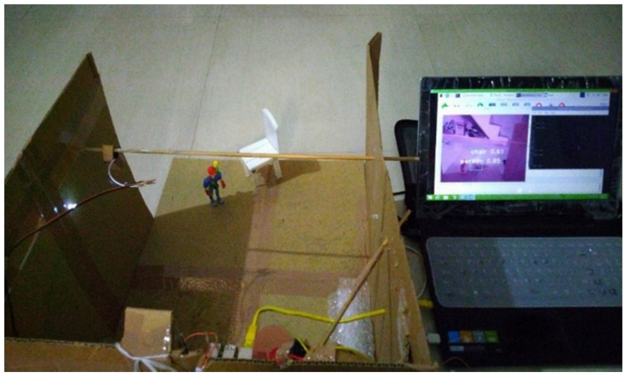


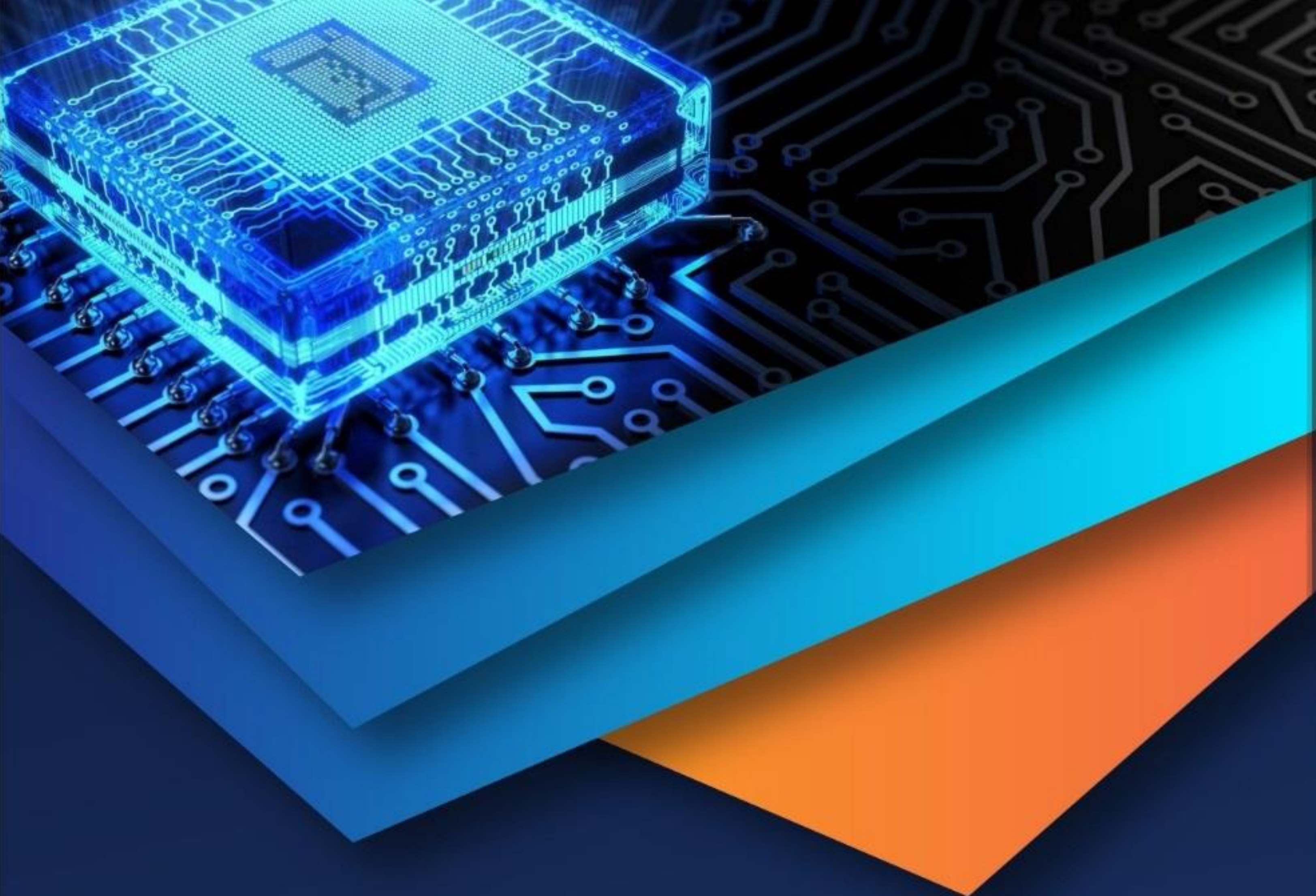
Fig 6. Model Human Detection on Left Side

V. CONCLUSION AND FUTURE WORK

The method proposed here deals with auto switching on/off of appliances inside a classroom. YOLO v3 algorithm along with Raspberry pi's camera is used to detect human presence and switch appliances on/off in a classroom is used in real time. However, in low light and if the distance is very far or small objects the accuracy of the algorithm drops. This method is scalable, agile, low maintenance and robust as there are no sensors used and lifetime of the system is high once in placed. Scalable in a way that "Attendance using face detection" or "Sentiment analysis of student's dung lecture" can be applicable with just manipulating the algorithm is the ultimate aim.

REFRENCES

[1] Zhou, X., Gong, W., Fu, W. and Du, F., 2017, May. Application of deep learning in object detection. In 2017 IEEE/ACIS 16th International Conference on Computer and Information Science (ICIS) (pp. 631-634). IEEE.
[2] Everingham, M., Van Gool, L., Williams, C.K., Winn, J. and Zisserman, A., 2010. The pascal visual object classes (voc) challenge. International journal of computer vision, 88(2), pp.303-338.
[3] Redmon, J., Divvala, S., Girshick, R. and Farhadi, A., 2016. You only look once: Unified, real-time object detection. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 779-788).
[4] Liu, C., Tao, Y., Liang, J., Li, K. and Chen, Y., 2018, December. Object Detection Based on YOLO Network. In 2018 IEEE 4th Information Technology and Mechatronics Engineering Conference (ITOEC) (pp. 799-803). IEEE.
[5] Redmon, J. and Farhadi, A., 1804. YOLOv3: an incremental improvement (2018). *arXiv preprint arXiv:1804.02767*.
[6] Onkar R. Kirpan, Pooja I. Baviskar, Shivani D. Khawase, Anjali S. Mankar, Karishma A. Ramteke 2017. Object Detection on Raspberry Pi. IJESC paper, 7(3).
[7] M. Piccardi, "Background subtraction techniques: a review," 2004 IEEE International Conference on Systems, Man and Cybernetics IEEE Cat. No.04CH37583, The Hague, 2004, pp. 3099-3104 vol.4.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY