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Design and Implementation of an Industrial Object Tracking using Image Processing Algorithms

B. Chitradevi[1]*, S. Yuvarani[2], S. Sivakumar[1], P. Karthikeyani[1]

[1]*Department of Computer Science, Thanthai Hans Roever College (Autonomous), Perambalur, Tamil Nadu, India.*
[2]*Department of Computer Applications, Thanthai Hans Roever College (Autonomous), Perambalur, Tamil Nadu, India.*

Corresponding author: citradevi.b@gmail.com

Abstract. Today's industrial workers deal with a variety of issues, such as accidentally hiding expensive items elsewhere and having to go looking for them. To solve this issue, we are entering the sphere of object finding and determining which supports businesses and research facilities. The task of creating an object search system is difficult. Real-time object search makes it extremely difficult to identify items. We are moving toward real-time image capturing and recognition methods, which will transmit data across embedded devices' Wi-Fi networks and fall under the umbrella of Internet of Things (IoT) advanced technologies. The image-based object recognition in the suggested system has been carried out utilizing MATLAB and IoT-based image transmission and reception methodologies. Here, two different 32-bit ARM microcontroller types are successfully utilized. With the help of the cam, the webcam is first installed in a microcontroller, and an image is then taken and sent to the Raspberry Pi. With the aid of a four-wheel robot, this image captures and transfer mechanisms are carried out in a real-time environment. The robot will move across a black line while being followed by an infrared (IR) sensor.

Keywords: Object detection, HOG algorithm, Image processing Algorithm, MATLAB, Industry maintenance.

INTRODUCTION

Object detection is a process of identifying objects and their properties in an image or video. This is used in industry for a variety of applications, such as security, surveillance, and retail. There are a variety of algorithms that can be used for object detection, and each has its own limitations. One common approach is to use a deep neural network (DNN) [1]. In this paper, we will be discussing object detection in industry and its various applications. We will explore the pros and cons of object detection methods, and finally, give a few examples of where object detection can be used [2]. Object detection has become increasingly important in recent years as it has become a key component of artificial intelligence (AI) and machine learning (ML) systems. Applications of object detection include autonomous driving, surveillance, and robot navigation [3].

Image processing and object detection have become an integral part of modern industry [4]. Object detection algorithms have been developed to automatically detect desired objects in images or videos for a variety of applications such as security, retail, and automotive [5]. Many different image processing techniques have been proposed for object detection including template matching, region growing, and Hough transform. However, each of these methods have limitations in terms of accuracy and computational efficiency [6].

Image processing is a field of signal processing where the input is an image such as a photograph. The image processing algorithms enable the significant improvement of an image. For example, an image with low contrast can be made more visible. In this paper, we will focus on the object detection in images using image processing. In many industrial applications, it is necessary to detect and localize objects in digital images. This is typically done

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using image processing. However, this process is limited by the quality of the images. If the objects are small or the image is noisy, the process may not be able to detect the objects [7].

To create, analyze, transmit, and present digital images, computer algorithms are used. Images gathering, processing, feature extraction, input image segmentation, interpretation, and substance identification are all significant terms in digital image processing. The automatic analysis and processing of digital images paved the way for several useful discoveries. The image data may be collected by cable, wireless, or satellite communications. The main steps in this procedure include finding, following, and assessing the object. Object tracking is the process of establishing the object's communication in succeeding frames. For surveillance, disclosing, and detecting in sensitive locations. Numerous trackers have been built to follow the object. Even though several object tracking techniques have been established, they vary in how they establish the unique equality of the object and its course of travel [8].

LITERATURE REVIEW

Due to improved network agility, including artificial intelligence (AI), and the capacity to deploy and automate systems, the Internet of Things (IoT) has an almost endless potential. Due to real-time computation, low power consumption, and cheap maintenance costs, embedded systems are essential to the Internet of Things. The goal of object detection, a computer vision technology, is to process and recognize certain items in digital photos or videos, such as people, cars, animals, or buildings. Creating computational models for computer vision applications is the aim of object detection. The momentum of object detection recently increased due to the rapid growth of deep learning techniques [9].

This article presents a state-of-the-art analysis of all current designs for metal and living item detection in WPT systems. To highlight their inherent limits and potential uses, main detection systems' working principles and qualitative comparisons in terms of sensitivity, accuracy, and cost are provided. To encourage more researchers to contribute to the creation and commercialization of wireless charging systems, several research subjects on foreign object identification are recommended [10].

The MATLAB code running on the PC extracts each image and uses the Real Time HOG function to compare it to the image retrieved from the repository until a match is made. If a contest occurs, the MATLAB procedure instructs the robot to halt the surveillance operation. If this occurs, the robot will issue a fresh start command, increasing monitoring. For real-time object recognition, MATLAB is using the updated HOG algorithm on the input image [11].

The robot can save images in a database. One prototype image for a variety of different things is stored in a database. The camera can be used to locate and identify passing items [12]. They may be picked up and placed in the final stage by the employed robots, who will then complete an assignment-like categorization. Here, a two-stage object recognition algorithm is proposed [13]. In the first level, distinct items are established and represented by polygonal forms [14]. The type of the items may be identified, and their relative orientation can be calculated in the second stage, which equalizes these shapes to the model [15].

PROPOSED METHODOLOGY

People who work in the industrial sector now have a lot of problems, such as hiding expensive materials or unidentified objects in one location and searching for them. We will research and learn which sectors and research institutions are helpful in addressing this challenge. It is challenging to create an object search mechanism. There are many issues with object recognition that arise while looking for real-time items. In fact, the study of object search and recognition systems is a very common topic in both academic and corporate facilities. The process of finding objects is difficult. The suggested approach uses machine vision techniques. The detection of things faces many difficulties when real-time object identification is used. This experimental project's primary focus is on object recognition utilizing the HOG method using an integrated architecture that has an ARM Cortex M3 processor for image classification and Wi-Fi standard image computing on it.

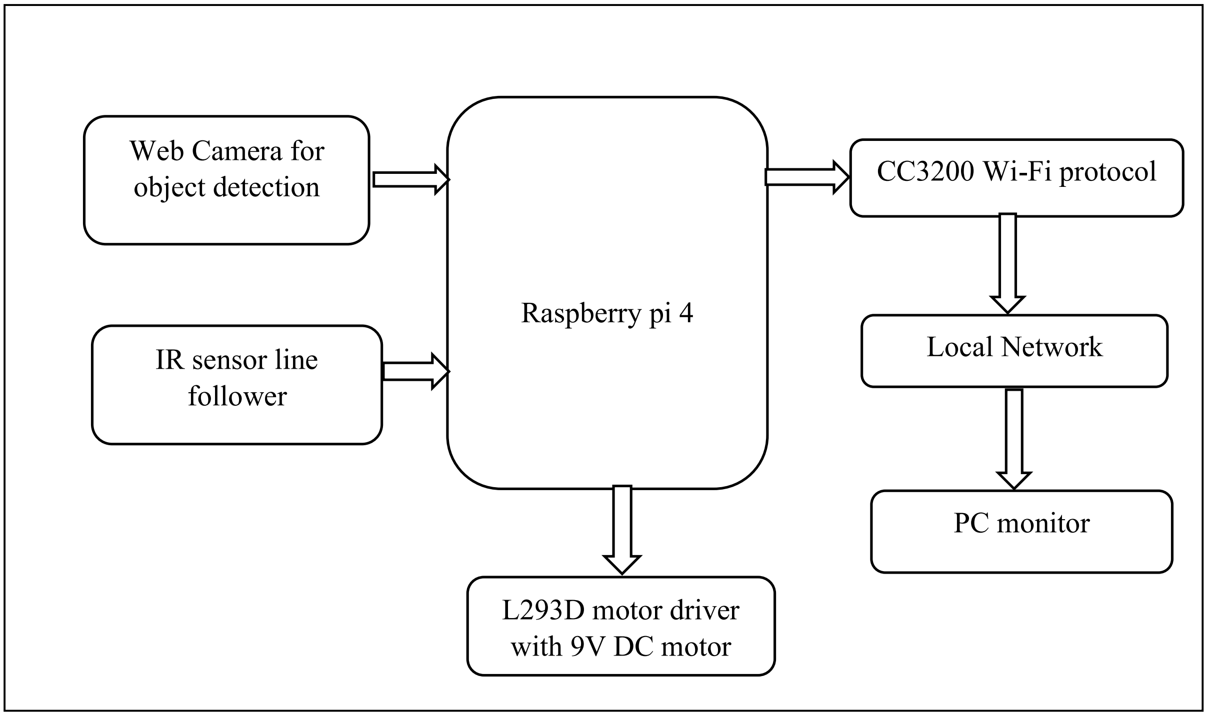

FIGURE 1. System architecture

The CPU will convey the images to the module through wired transmission, as shown in Figure 1, using the cam port via which the signals are sent. Then using the UART communication protocol from the CC3200. The camera's output is a large, high-quality image. The high-definition image is converted into several coded bits into split images before being sent to the CC3200 input port. The divided images then go via communications channels to the PC. With complete user control over image quality, output data transmission, and UXGA resolution up to 15 frames per second (hps), this device includes a photo array. Hue saturation during colour balance. The SCCB interface, among other things, enables white pixel suppression of noise. For added power, the OV2640 also has a compression engine. Additionally, OmniVision Chip's use special sensor technology to improve image quality by reducing or eliminating standard illumination.

A MATLAB system with all the vehicle and webcam functions is developed in this assessment. A unique object ID has been assigned to each item image. If the equipment operator attempts to still have any object, the corresponding object ID number will be supplied, and MATLAB will properly associate the item with the image in the registry and send the start order. These photographs will be accessed with the ID number. The MATLAB code on the personal computer retrieves individual objects and uses the HOG algorithm to evaluate it to the image downloaded from the server until a determination is reached. If a match is found, MATLAB makes tremendous progress in stopping the monitoring process. If not, a new beginning order to increase monitoring will be sent.

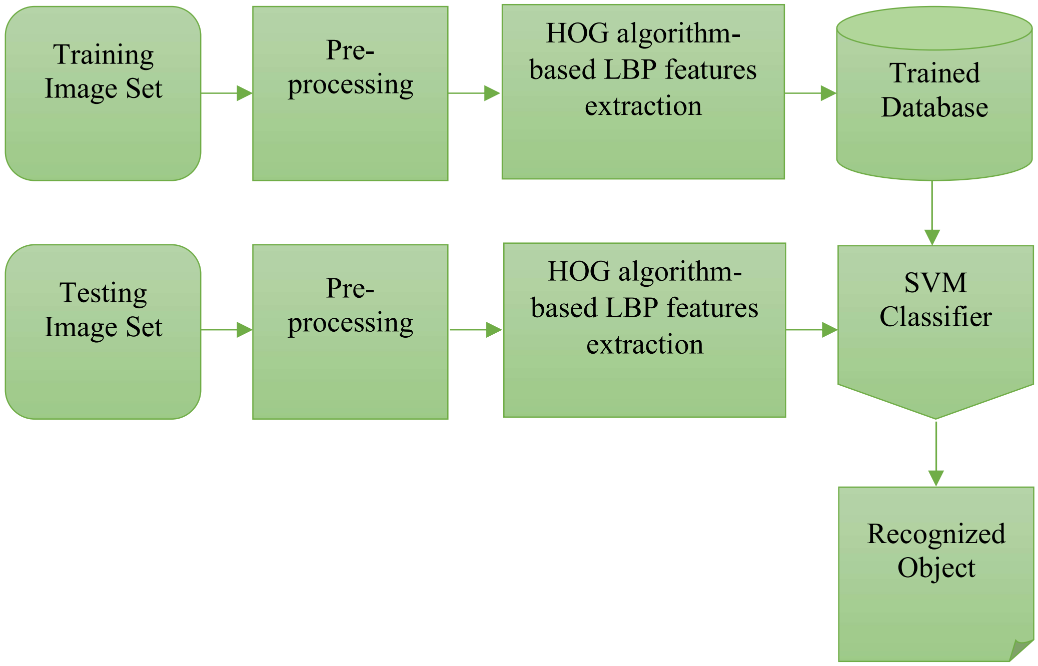

FIGURE 2. Model of the system

RESULTS AND DISCUSSIONS

The high-definition image is decoded into several composing into split representations and then sent to the input port of the CC3200. The divided images are then transmitted to the PC through Ethernet standards. Since there is no packet loss, the IP will be established for the transmission, and the packets are transferred in a lossless manner with a very short transmission time. Due to the absence of the acknowledgment mechanism in this system, there is no delay or packet loss brought on by the lengthy acknowledgement process. Immediately and with minimal delay, packets are delivered, improving speed.

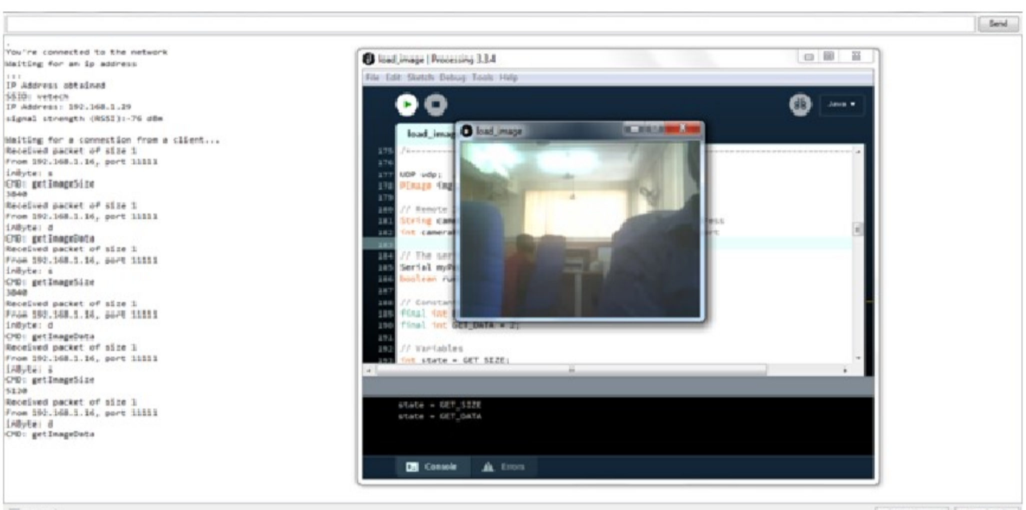

FIGURE 3. Proposed results in PC

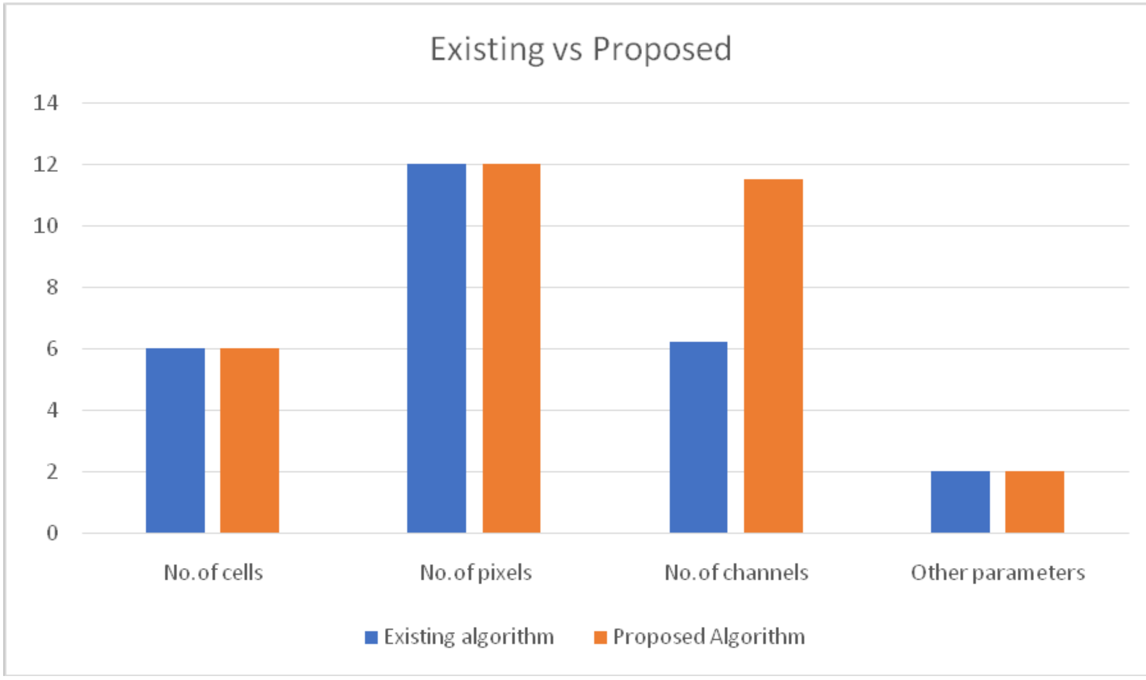

FIGURE 4. Existing vs Proposed model

The graph in Figure 4 illustrates the difference in parameters between the existing and suggested algorithms because of our optimization of the parameters using a variety of strategies.

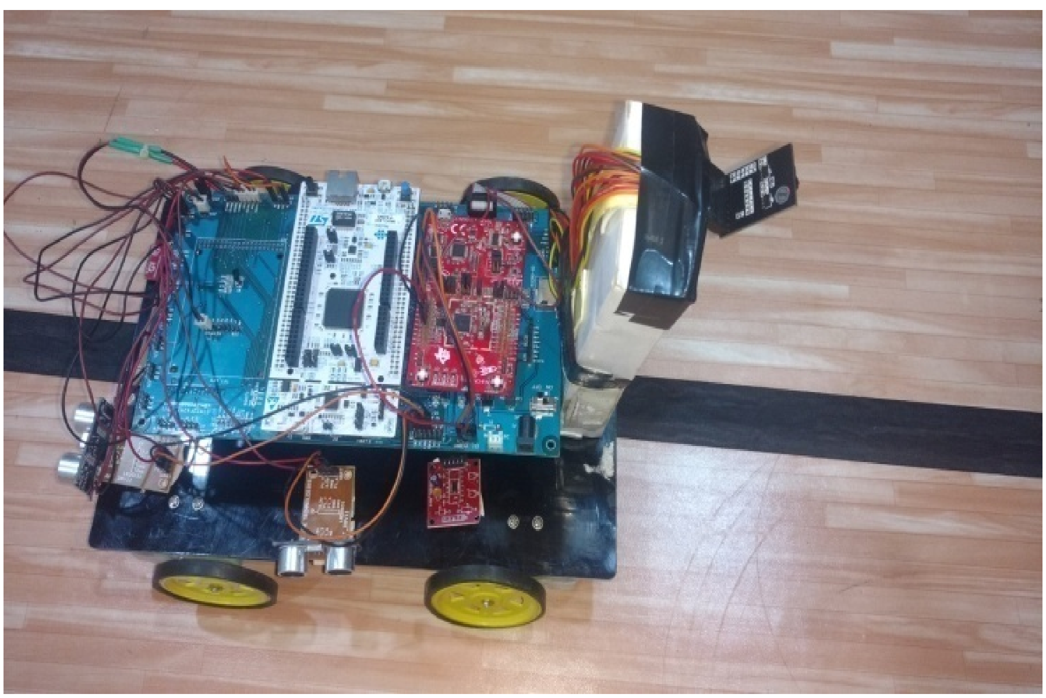

FIGURE 5. Hardware implementation

The photographs will then be divided into additional pieces and stored as a file. The document will be stored in the memory for later use. After receiving the command, the file is accessed, and the image is then transferred to the CC 3200 via UART. Now that digital signals are being communicated through Wi-Fi, the image will be sent to the following stage for additional processing, which will involve MATLAB data processing. In this manner, the industrial object is recognized, and the robot moves in accordance with the submit command from the MAT LAB image processing.

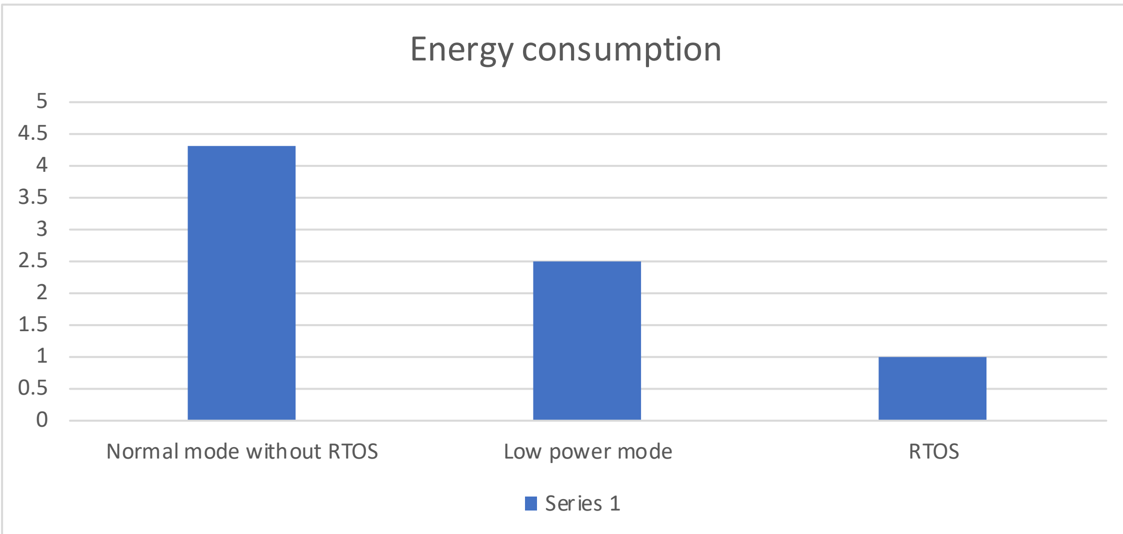

FIGURE 6. Energy consumption

Figure 6 shows a graph that contrasts power usage with and without an RTOS. By customising the Cloud computing tool for energy consumption and cost-saving caching and encryption, which is given by the platform by default, the construction and operational expenses would be lowered overall by 17%.

CONCLUSION

The suggested module is to create a mechanical subsystem for a manufacturing industry to watch over and find any anomalies. Here, the system first makes use of an Input camera interface to take images, which are then transmitted to the program for effective image identification using Lab view software. Using IoT technology and internet tools for transmission and storage, the entire process has been made real time. We employ the UDP protocol during transmission because it is excellent for quick and lossless delivery. The efficiency is also improved, and the installation is made easier and more affordable because we are employing a real-time environment. Overall, this study project focused on the robotic module's object recognition procedure was effective thanks to the use of MATLAB's upgraded HOG algorithm to locate the target object. Using an IoT network, the object identification system is now being monitored live. Through the internet, the user can always be in contact with the module and control it from anywhere in the world.

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