Implementation of Internet Connected Industrial Robot Using Hog Algorithm based Object Recognition

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Abstract - The main focus is on object searching and recognition which is a popular area which increases tremendously in industries and research labs. The proposed work is based searching of an object which is done with the help of computer vision techniques. But in real time object searching will have many difficulties when the recognizing of an object is been done. To overcome this problem there is an improved technique called HOG Algorithm is been used in the real time situations. As the result the performance of the object searching in the present experimental scenario is evaluated through the integrated hardware, which is synchronized with a camera and embedded system based wheeled robot.

Keywords: Cortex-m4, camera, Wi-Fi, PC, Object recognition, Histogram of oriented gradients algorithm, Local binary pattern features, Support vector machine classifier.

1. INTRODUCTION

The object management in the industrial environment is very important because the environment present in the industry is very tidy. The works that fully depend on human interactions like searching, packing, carrying, dispatching etc. Repetitive type based activities are important for object management to do tedious work. Avoiding human interaction between these sort of works will reduce more errors in the management[28].

This paper describes the Traffic light mapping, localization, and state detection for autonomous vehicles [1]. The paper involves the Traffic light recognition using image processing compared to learning processes [2]. This paper says the Real time visual traffic lights recognition based on spot light detection and adaptive traffic lights templates [3]. This paper illustrates the Robust and Real-Time Traffic Lights Recognition in Complex Urban Environments [4]. This paper determines the Traffic Light Mapping and Detection [5]. This paper explains the Traffic light detection with colour and edgeinformation [6]. The Recognition and Tracking of Traffic Lights Based on Colour Segmentation and CAMSHIFT for Intelligent Vehicles is done in [7]. This paper involves the Traffic Lights Detection in Adverse Conditions using Colour [8]. The paper says the Suspended Traffic Lights Detection and Distance Estimation Using Colour Features [9]. Detection of Traffic Lights for Vision Based Car Navigation System is discussed in [10]. Traffic light detection during day and night conditions by a camera is described in [11]. Bayesianfiltering for location estimation is done in [12].

2 IMAGE PROCESSING USING MATLAB SOFTWARE:

2.1 Object searching system:

The automatic object searching and recognition has been done in the proposed system. To reach this goal the implementation of computer vision techniques is been done. By using the improved version of HOG algorithm, the real time object recognition has been implemented. For a real time robust object recognition scale invariant features should be considered. Integrating local feature matching techniques to HOG algorithm makes more efficient. The local feature approach can easily incorporate novel feature types because extra features
contribute to robustness when they provide correct matches, but otherwise do little harm other than their cost of computation. Therefore, future systems are likely to combine many feature types.

![Flowchart of existing system](image)

**Figure 1**: Flowchart of existing system

A MATLAB image processing with all the robot and camera controls will be developed. A database of all the images of the objects are created and preserved. This database is interfaced with MATLAB. The images of objects were assigned with different object ID nos. These images can be accessed using that ID nos. when the system operator wants to get one object, then he inputs the corresponding object ID no. Then the MATLAB process matches the product ID with its image in database and it sends a start command to the robot unit to gather a new image which is moving on a pre-planned path is shown in figure1[15].

The MATLAB process running on the PC collects each image and compares with the image extracted from the database using Real Time HOG algorithm,Until a match is found. If there is any match, the MATLAB process sends a stop command to the robot, which will end the surveillance process. If not, it issues a new start command to the robot, extending the surveillance.
3. HARDWARE INTEGRATION

3.1. Line following sensor:
3.1.1. IR Transmitter and Receiver:

A photodiode is a type of photodetector capable of converting light into either current or voltage, depending upon the mode of operation as shown in Figure 2. Many diodes designed for use specifically as a photodiode will also use a PIN junction rather than the typical PN junction. Most photodiodes are similar to a light emitting diode[14]. They will have two leads, or wires, coming from the bottom. The shorter end of the two is the cathode, while the longer end is the anode. See below for a schematic drawing of the anode and cathode side. Current will pass from the anode to the cathode, basically following the arrow. The best frequency for the job is between 30 and 60 kHz, the most used is around 36 kHz. Remote controls use the 36 kHz (or around) to transmit information. Infra Red light emitted by IR Diodes is pulsed at 36 thousand times per second, when transmitting logic level "1" and silence for "0". To generate a 36 kHz pulsating infrared is quite easy, more difficult is to receive and identify this frequency. It has an output pin that goes high (+5V) when there is a pulsating 36kHz infrared in front of it, and zero volts when there is not this radiation[16].

A photodiode is a PIN junction or PIN structure. When a photon of sufficient energy strikes the diode, it excites an electron thereby creating a mobile electron and a positively charged electron hole. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced[17], [18], [19].

The IR light that was emitted from another led of the exact same type! This is an electrical property of Light Emitting Diodes (LEDs) which is the fact that a led produces a voltage difference across its leads when it is subjected to light. As if it was a photo-cell, but with much lower output current. In other words, the voltage generated by the led’s can't be - in any way - used to generate electrical power from light, It can barely be detected[20].

As the name implies, the sensor is always ON, meaning that the IR led is constantly emitting light. This design of the circuit is suitable for counting objects, or counting revolutions of a rotating object, that may be of the order of 15,000 rpm or much more. However this design is more power consuming and is not optimized for high ranges[21]. In this design, range can be from 1 to 10 cm, depending on the ambient light conditions.

The sender is composed of an IR LED (D2) in series with a 470 Ohm resistor, yielding a forward current of 7.5mA[23].

The receiver part is more complicated, the 2 resistors R5 and R6 form a voltage divider which provides 2.5V at the anode of the IR LED (here, this led will be used as a sensor). When IR light falls on the LED (D1), the voltage drop increases, the cathode's voltage of D1 may go as low as 1.4V or more, depending on the light intensity. The output will be High when IR light is detected, which is the purpose of the receiver.
Using infrared signals, controller is able to localize the position of devices. With the relevant upgrade, microcontrollers also allow two-way data exchange between two devices. The transmitter and the receiver face each other. The transmitter and receiver have to be positioned so that they are opposite of and within sight of one another. There is a window for the optical signals at the front (IR receiver/transmitter, status LEDs).

The transmitter should be mounted in a protected environment. The receiver is to be mounted in some place. Transmitter mounted at any place. Transmitter and receiver must be parallel in their axes and point towards one another.

3.2 Four Wheel Robot Setup:
3.2.1 L293D Motor driver:

The typical motor driver used to drive the motor in any directions is L293D. The simultaneous rotation of two DC motors is controlled by a 16pin IC called L293D. Here inside the L293D a Dual H-bridge is used to control two DC motors[27].

The microprocessor or controller is used to transmit the relative signals to motor through the L293D. There will be two voltage pins used; one of these is used to draw current for the working of the L293D and the second one is the applied voltage to the motor. The supply voltage does not change due to this.

The motor driver is used as a type of current amplifier; the function of the motor driver is to operate in higher-current signal which drives a motor with low–current control signal.

![Figure 3: Circuit diagram of L293D](image)

The L293D is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors.

Drivers are not used only for motors. They are used for any device that usually draws more than 50-100 mA. Maximum current of microcontroller output (typically 10-20mA) is not enough to drive motor coil. Connecting motor directly to microcontroller will damage microcontroller output transistor.

An H bridge is an electronic circuit that enables a voltage to be applied across a load in opposite direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards.

3.2.2 Operation of four wheel Robot:
The above shown figure shows the four wheel set up of the Robot. Here the robot is been operated with the help of L293D motor driver as the circuit of motor driver works with the H-Bridge circuit and pulse generated from the controller.

4. RESULT

Object classification is an important task in many computer vision applications, including surveillance, automotive safety, and image retrieval. For example, in an automotive safety application, you may need to classify nearby objects as pedestrians or vehicles. Regardless of the type of object being classified, the basic procedure for creating an object classifier is:

- Acquire a labeled data set with images of the desired object.
- Partition the data set into a training set and a test set.
- Train the classifier using features extracted from the training set.
- Test the classifier using features extracted from the test set.

Here OV2640 is used to capture the image and after the image is captured image will be send to STM32f476zi an embedded 32 bit ARM microcontroller and that image will be spitted into several parts and it will be send to memory card from the memory the image will be send to CC 3200 through UART serial communication Via Wi-Fi and LAN the image will be send and received to process it in MAT Lab image processing. By this way the object recognition is done and robot will move according to the command send from the MAT LAB Image processing.

When the MAT Lab sends the START command the device searches the object until the object is been identified after the object is identified MAT Lab sends the stop command. Then, again the procedure will be repeated until the object searching is completed.
5. CONCLUSION

In the proposed system the image based object recognising using MAT Lab and IOT based image transfer and receiving techniques is been done. Here two types of 32 bit arm controllers are effectively used. First in one controller the camera module is been connected with the help of camera, image is been captured and send to the STM32F426zi and through the UART to CC3200 WI-FI based controller through which the image will send to the MAT Lab to do the image comparison with object database which is already stored in our MAT Lab. This image capture and transfer mechanism is done in a real time environment with the help of a four wheel robot and the robot will be moved through black line following which is done by IR sensor. By this way the proposed system is been effectively utilised.

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