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Floating Waste Scooper Robot On Water Surface

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Abstract: In developing countries, cleaning water surface is a routine task collecting a huge number of floating dry waste, such as plastic bottles, encounters tension on the water surface, and the garbage floats away due to the little drag force. The goal of this study is to create a robot that can perform floating trash scooping in place of humans, as well as to evaluate the effectiveness of the planned waste scoopers installed on the Floating Waste Scooper Robot. The design of the robot mechanism, waste scoopers, and control are all discussed. On a calm sea surface, the robot was successfully tested. Experiments were carried out on a pond, and the results reveal that changing the robot driving speed and the conveyor belt speed has an impact on garbage scooping. The capability of various scooper designs is assessed, and the weight of plastic bottles gathered by humans using scoop nets is compared to the weight collected by robots.

Index Terms **– Dry Waste, Robot, Scooper, Water Surface Cleaning, Image processing**

I. INTRODUCTION

The increasing volume of dry waste in canals, ponds, and lakes in developing countries has an impact on water drainage and the quality of life of individuals living near those locations. Plastic fragments, foams, tree leaves, and aluminum bottles are common floating garbage. The accumulation of dry garbage floating on the water surface can clog city canals and create flooding. As a result, water surface cleaning must be done on a regular basis.

Dry trash, such as foams or plastic bottles, can be plainly seen on the water surface due to their lower specific weight than water. Because the trash has a low drag force and the surface tension of the water generates a surface wave, the garbage normally flows away when arriving by ship or boat. Humans typically gather rubbish using a scoop net with a long handle. However, when the volume of garbage is considerable, the operation necessitates a lot of effort from the cleaning crew.

II. OBJECTIVE

The typical waste collecting by human is often done by using scoop net with long handle. However, the operation requires much effort of cleaning team when amount of waste is enormous. In this work, we focus on collecting plastic bottles floating on water surface. Here we are presenting a cost-effective remote controlled robot with control features that can assist the humans in removing the floating water waste safely and quickly making work easier and more sustainable.

III. MOTIVATION

It is a well-known fact that nearly 70% of the earth is filled with water in the form of different kinds of water bodies such as oceans, lakes and rivers etc. The careless human intervention has badly affected the oceanic ecosystem, threatening the existence of several other species on earth, including human beings. Dumping sewage in the ocean has always been considered the cheapest and the easiest way of disposing of wastes. The billions of tons of litter end up in the ocean each year reportedly bring 250 million tons of trash into the sea every year. However, reports also suggest that littering makes the aquatic life in the oceans and seas worse in these days. Often found floating waste is such as plastic scraps, foams, tree leaves, and aluminum bottles. Accumulating of the dry waste floating on water surface can obstruct water drainage in city canals and cause floods.

IV. LITERATURE REVIEW

Unmanned surface vehicle has been developed since 1993 for various missions such as testing of navigation and control systems, ocean exploration, fish tracking, or military applications [1]. The vehicle platforms were often made of pontoon or kayak with propeller and rudder. Similar structure has been expanded on lake surface cleaning ship where flight conveyor is mounted in the front for collecting garbage or rubbish. As for water surface cleaning, previous works focused on robot maneuvering control and autonomous motion control using hydrodynamic model [2-3].

A chain conveyor belt was mounted between pontoons for collecting rubbish. The maximum driving speed was at 1 m/s and the conveyor belt speed was about 0.2 m/s [4]. In parallel, an autonomous ship for garbage cleaning around bank of a lake was proposed [5]. A flight conveyor belt was rubber with holes and aluminum fins were zig-zag shape. Later, an autonomous aquatic multi-robot system for lake cleaning was presented [6]. A track belt system was used for removing weeds. The maximum driving speed at full load was 0.38 m/s and simulation approximating for amount of collected waste in large area was proposed.

In previous works, the pontoon was often selected since it can reduce surface wave generated when reaching the waste and different kind of belt system was selected depending on type of waste to be collected. The capability of waste collecting was evaluated in the simulation whereas the robot speed and the conveyor belt speed were kept constant.

V. BLOCK DIAGRAM

The proposed block diagram (**Fig.1**) consists of a camera for capturing the images to detect the waste and it is sent to Raspberry pi for processing it. The arm is used to pick up the waste towards the conveyor belt. DC Motor is used for moving the robot. Solar panel is used as the power supply for the robot.

VI. METHODOLOGY

The robot will move towards waste by means of camera connected to it, the robot moves through two wheels connected to a DC motor. The wheels will be semi controlled by a mobile app that communicates to the robot via Wi-Fi. As the pick and place arm will pick up the waste and places the waste towards the conveyor belt, the moving belt drags the waste and dumps it in the bin attached at the back. When the bin starts filling with the waste it will notify the level of waste in the bin to person operating the robot via ultrasonic sensor. The entire robot will be powered by solar panels. The robot can detect the type of waste and will notify the user.

VII. OBJECT DETECTION

7.1 Convolutional Neural Network (CNN):

CNN is mainly used for image recognition and image classifications. In CNN image classification takes an input image, process it and classify it under certain categories. CNN is an another type of neural network that can be used to enable machines to visualize things and perform tasks such as image classification, image recognition and object detection etc. Image classification is the task of taking an input image and outputting a class (car, bike, truck, etc.) or a probability of classes that best describes the image. CNN is specialized type of neural Network model designed for working with image data.

A computer should differentiate between all the images it is given. For that computer perform image classification by looking for low-level feature such as edges and curves then building up to more abstract concept through a series of convolution layer. In CNN the input image pass through a series of convolution layer and, pooling (down sampling) layer and fully connected layer and finally produce the output which can be simple class or probability of classes at best describes the image.

Convolutional layer perform an operation called a convolution, hence the neural is called convolutional neural network. It extract features for the input image. Convolution is a linear operation that involves the multiple of a set of weights with the input.

Figure 2 shows the neural network with many convolution layer. Initially give the different input images to neural network, each images are classified into 2 hidden layers. In the first hidden layer convert all RGB image to Gray scale image and in second layer Gray scale image matches with the expected image.

7.2 YOLO — You Only Look Once:

YOLO or You Only Look Once is an object detection algorithm much is different from the region based algorithms which seen above. In YOLO a single convolutional network predicts the bounding boxes and the class probabilities for these boxes as shown in **fig.3**.

YOLO works by taking an image and split it into an SxS grid, within each of the grid we take m bounding boxes. For each of the bounding box, the network gives an output a class probability and offset values for the bounding box. The bounding boxes have the class probability above a threshold value is selected and used to locate the object within the image. Non Maxima suppression is used to remove multiple detections.

YOLO is orders of magnitude faster (45 frames per second) than any other object detection algorithms. The limitation of YOLO algorithm is that it struggles with the small objects within the image.

Output:

The robot is designed to scoop the waste on the water surface as shown in the **fig 4**.The robot uses image processing technique for detecting the waste as shown in the **fig 5**.The project is working as excepted.

VIII. HARDWARE IMPLEMENTATION

Raspberry pi is the brain of the robot. Which controls the robot mechanism and also the waste detection part with the help of camera connected to the controller. The H Bridge is used to drive the DC Motor of the robot. The pick and place arm is used to pick up the waste and place it towards the conveyer belt. The entire the robot is operated by solar energy by solarpanel.

IX.FUTURE SCOPE

In the future the entire robot can be fully automatic and it can be covered by casing mechanism to keep the robot on water surface. The system may also encompass a broad domain of use-cases. It can particularly be used for nuclear-waste collection, where human presence is unsafe. It is primarily proposed for a "smart city". The robot arm can be made rotatable for ease purpose of waste collection.

X. CONCLUSION

The structure of the Floating Waste Scooper Robot is presented in details. The robot can be both manually operated and run automatically. The robot arm will pick the waste by the help of camera connected to it. Scoopers are made of plastic net and cause small surface wave amplitude when compared with rubber. Difference in term of mechanism has much influence on scooping the floating plastic bottles. Capability of the designed waste scoopers was successfully evaluated. A motion control strategy based on ultrasonic distance measurement is put forward. By analyzing the distribution characteristic of the garbage floating on a lake, a method for cleaning up floating garbage round the bank of the lake has been brought forward Experiments have already demonstrated that the design of the autonomous cleaning robot for cleaning floating garbage on a lake is applicable. Therefore, the FWSR is proven to be capable to replace labor for water surface cleaning.

XI. Figures

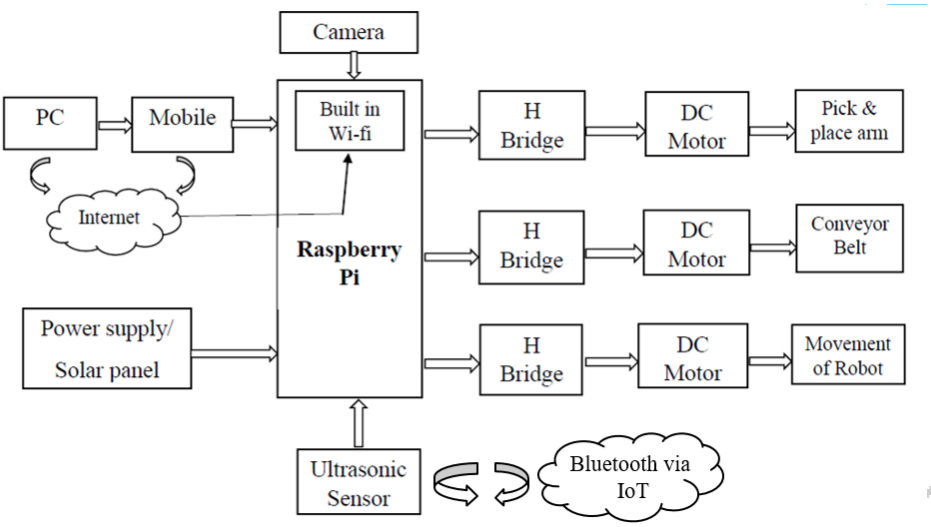

Figure 1

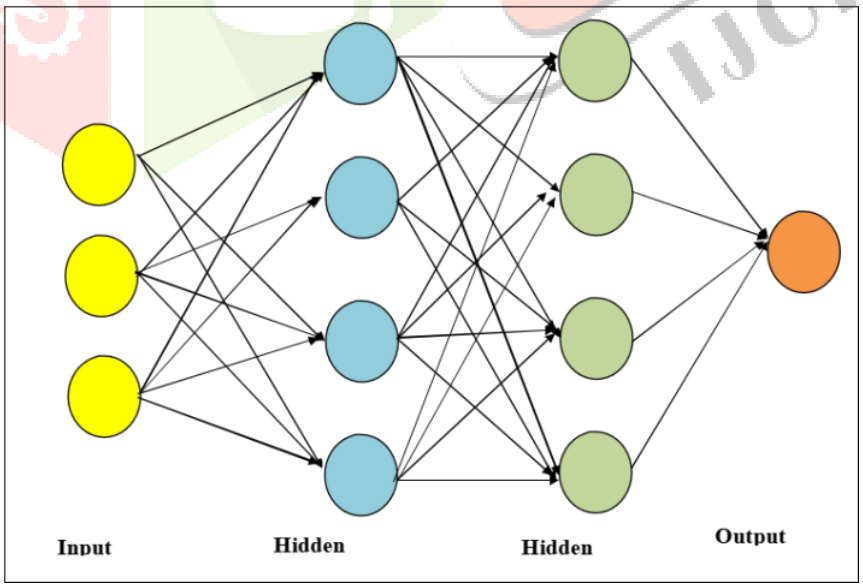

Figure 2

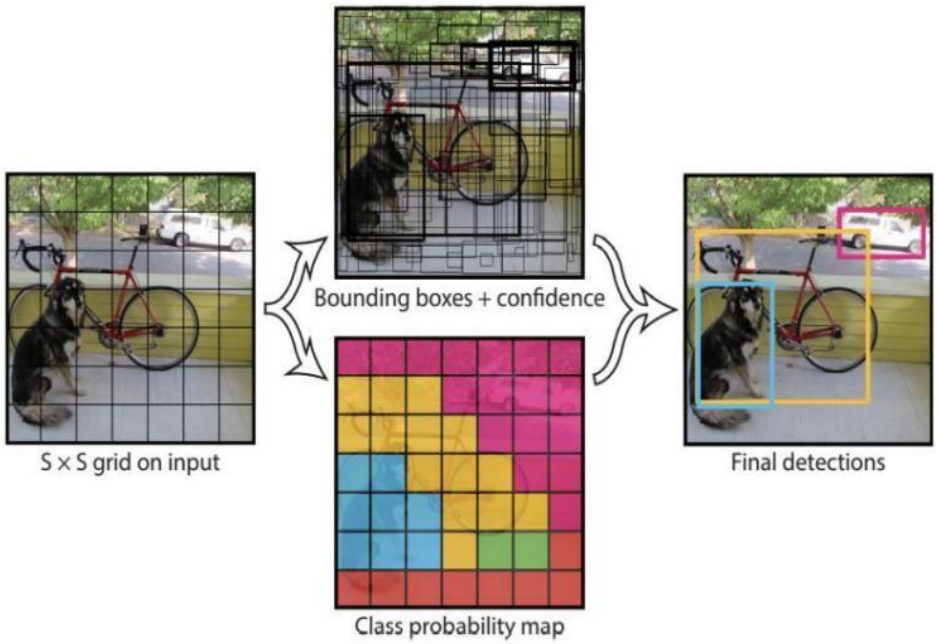

Figure 3

Figure 4

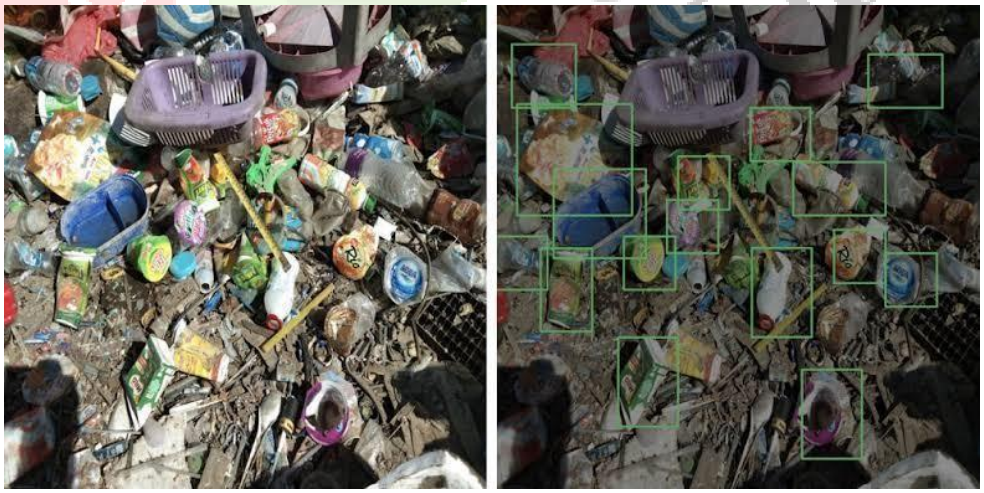

Figure 5

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