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DETECTION, LOCATION AND PICKING OF THE OBJECT BASED ON MACHINE VISION

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Abstract - *India stands as a developing country in automation field using machine vision for automatic detection, location and picking of different objects in various areas like industries (for bin-picking using robot manipulator), Medicine (for detection and correction of the correctness of the process), Defence and ordinance factory (for detection and disposal of the bomb) and Agriculture (for fruit picking, sorting and packaging) which makes the task easy, accurate and speedy compare to the any manual processes. There are so many challenges to detect, locate and pick exact location of an object and needs a lot of correction or optimizations in the system available now a days. Considering the challenges and scope, this paper will introduce an optimized methodology for obtaining the accurate 3D map of an objects present in the work place for efficient detection, location and picking of the predefined object. This paper will be useful to develop speedy, accurate and efficient Gadget for picking the predefined objects based on Machine Vision to improve the time, positioning accuracy and picking efficiency and also helpful for those regions in the country specially which are facing labour problem.*

***Key Words*: Digital Image Processing, Embedded, Pick and Place Robotics, RGB colour sensing, Identification.**

1. INTRODUCTION

A new, perceptual, approach to detect, locate, pick and place a real time captured object is discussed. Harvest and picking takes much time and effort in the course of fruit and vegetable cultivation, to improve the agricultural production costs, to develop a mechanized harvesting and picking technology for enough supply of safe vegetables. However, if the robot is to assist a human e.g. in a complex assembly task, it is necessary to have means of exchanging information about the current scenario between man and machine in real time. The positioning of object and measuring distance are not only the important factors which affect the picking quality but also the main points and difficult points of the picking robot vision system. The related concepts are object recognition and Image classification. The goal of object detection is to detect all instances of objects from a known class, such as fruits, balls, cubes, people faces, cars etc. in an image. Typically only a small number of instances of the object are present in the image, but there are a very large number of possible locations and scales at which they can occur. Texture-less, smooth and uniformly colored objects occur frequently in robotic applications that range from personal robotics to intelligent manipulation and assembly. Common to such applications is the requirement of identifying and accurately localizing known objects so that they can be acted upon by a robot end effecter. Images of objects from a particular class are highly variable. One source of variation is the actual imaging process. Changes in illumination, changes in camera position as well as digitization artifacts, all produce significant variations in image appearance, even in a static scene. The second source of variation is due to the intrinsic appearance variability of objects within a class. The challenge is to develop detection algorithms that are invariant with respect to these variations and are computationally efficient.

1.1 Proposed system

In this project the proposed work will develop speedy, accurate and efficient Gadget for picking the predefined objects based on Machine Vision to improve the time, positioning accuracy and picking efficiency. The proposed work will be helpful for those regions in the country specially which are facing labour problem. Also the limitations of visual theory, image analysis algorithms and hardware, machine vision technology to the practical application and commercialization of the agricultural machinery still have some distance. To overcome that distance with increase in accuracy these propose work introduces an optimized methodology for obtaining the accurate 3D map of an objects present in the work place for efficient detection, location and picking of the object based on Machine Vision.

2. LITERATURE REVIEW

After studying various papers, the technologies implemented were found to be as follows:

Lv Xiao-lian, Lv Xiao-rong, Lu Bing-fu introduced "Identification and location of Picking Tomatoes Based on Machine Vision" in 2011 Fourth International Conference on Intelligent Computation Technology and Automation in that they used visual system with segmentation in difference between the color charactoristics of ripe tomatoes and background. They find centroid of picking tomatoes, Location information is determined through three-dimensional reconstruction method of space point. This system applicable only for matured and unmatured tomatoes.[1]

From the 1980s, the Western developed countries such as Japan have been working at the harvest and picking robot and have developed artificial intelligence robot to pick vegetables (Sario et al., 1993; Kondo et al, 1996; Shigehiko et al.). However, these vegetable and fruit picking robots can't adapt to the external environmental changes due to limited sensitivity, which affect their promotion (Hollingum, 1999). Therefore, it is still far from practical application (Xu et al; Fang et al; Cai et al., 2005.). Jinwei Yu, Jian Song, Xueyan Sun they introduced "Design and Experiment of Distance Measuring System with Single Camera for Picking Robot" in that they suggest a method of measuring distance with single camera for picking robot, detect outline area, center of gravity, enclosing rectangle and the point to cut off are distilled through counter tracing. Limitation is when distance is smaller its error is bigger because of camera aberration.[2] Pavel Dzitac and Abdul Md Mazid introduced "A Depth Sensor to Control Pick-and-Place Robots for Fruit Packaging" in 2012 12th International Conference on Control, Automation, Robotics & Vision Guangzhou, China, 5-7th December 2012 (ICARCV 2012) in that they suggested a powerful and inexpensive method for object detection and location using a low cost, commercial 3D depth sensor using Microsoft visual C# 2010 software. They suggested paper which makes use of a low cost, commercial sensor and common application development tools and methods that allow the user to customize the application. Optimum awareness mechanism is to be implemented.[3] In 2013 according to Dirk Buchhol & Marcus Futterlieb, they introduced "Efficient Bin-Picking and Grasp Planning Based on Depth Data"(2013 IEEE International Conference on Robotics and Automation (ICRA) Karlsruhe, Germany, May 6-10, 2013) in that they suggest "Applicable solution for bin picking problem based on standard 3D sensor and their Approach for collision avoidance that effectively reduces system cycle time" they use RANSOM (Random sample matching algorithm) to solve 3D capturing problems. Costly and Iterative procedure is involved.[4]

Distance measuring is not only an important factor in influencing the positioning accuracy of picking target but also a challenging research of automated picking robot using 3D machine vision technique. However, a new approach in followed by present methodologies of detection, location and picking the object by the means of RGB image sensing acquisition also finding X,Y,Z location of an object (starting point, Depth point, End point) is suggested and proposed herein.

2.1 Literature Review & Comparisons

Author	Paper Title & Publication	Technology / algorithms	Efficiency & Linearity	Application	Limitation
Lv Xiao-lian1 Lv Xiao-rong Lu Bing-fu	Identification and location of Picking Tomatoes Based on Machine Vision	median filter segmentation; identification; centroid matching Machine Vision	98% - mature fruit 89% - green ripe fruit	agricultural machinery	System applicable only for matured and un-matured tomatoes.
Jinwei Yu Tiezhong Zhang	Design and Experiment of Distance Measuring System with Single Camera for Picking Robot	Image processing algorithms	Measuring error ±18mm when distance ranges 275-575mm	Agricultural and Industrial machinery	Distance is smaller its error is bigger because of camera aberration. Gives results near to optimal solution
Pavel Dzitac Abdul Md Mazid	A Depth Sensor to Control Pick-and-Place Robots for Fruit Packaging	3D depth sensor	_	Industrial automation robotic pick-and-place application	It is iterative method
Dirk Buchholz, Marcus Futterlieb, Simon Winkelbach and Friedrich M. Wahl	Efficient Bin-Picking and Grasp Planning Based on Depth Data	RANSAM algorithm and reduce cycle time of system	_	Bin picking and object localization	Difficult to recognize object in complex environment

Table 1: Literature review & Comparison

3. METHODOLOGY:

The following methodologies will be adopted for completing the proposed work:

1. **Prerequisite:** The three dimensional position of objective and measuring distance are not only the important factors which affect the picking quality and comparative study of relevant literature survey to use/suggest the best methodology and accordingly modify the proposed work is needed.

2. **Image Acquisition:** The image of object automatically captured using High resolution camera.

3. **Image Segmentation**: the captured image of object plant processed (i.e. the captured RGB color image will be firstly converted into Gray scale and then resultant image converted into Binary Image using adaptive thresholding and noise is removed by filtering) using software package like Microsoft visual basic 2008 (.NET), Labview, MATLAB, and related with hardware platform.

4. **3D positioning:** The Binary image and Vision algorithm used to compute 3D location of each object. (i.e. x,y,z coordinates start point, Depth point, End point)

5. **Interfacing Robot manipulator:** the exact xyz coordinates obtained from above algorithm communicated to driving/controlling to DC motors or servo motors of X-DOF robot manipulator.

6. **Calibration & Performance Analysis:** the complete Gadget used in real time and calibrated to check its performance, accuracy and efficiency.

4. PROPOSED RESEARCH FLOW DIAGRAM:

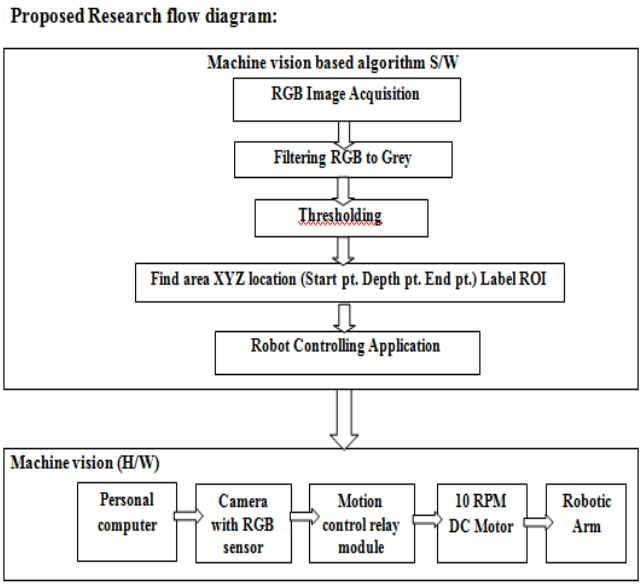

Fig -1: Proposed research flow diagram.

5. HARDWARE DESIGN

Block diagram of system is shown in Fig 2. The whole system designed, which is interface to PC, Max 232, Microcontroller (AT89C51), I/O Control circuits and robot. These all entire components used in system are described below:

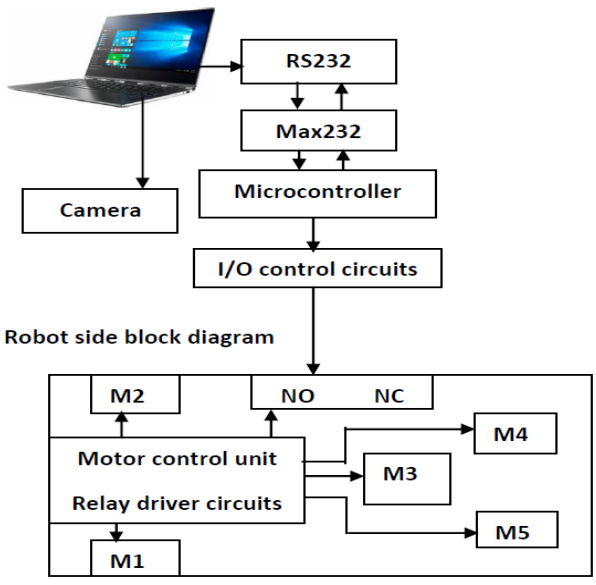

Fig -2: Block Diagram of system design for Object Pick And Place using Machine Vision System

6. SCOPE

Due to Development of efficient object picking gadget:

1. It is possible to detect, locate and picking of the object based on machine vision and will be the cost effective solution to the labour problems, reduces the processing time.

2. Is possible to enhance the Automation R&D using the machine vision platform for the growth of the country.

7. CONCLUSION

The algorithm presented has been shown in an effective way of determining the pose of an object when using the RGB sensing camera to achieve successful pose estimation. A new Measuring method for Distance calculations by means of RGB sensor may meet the needs of picking Robot. Also the proposed system avoid complex calculations needed to meet the work require for picking robot. An efficient Machine Vision technique can be developed using Image processing platform to optimize the object picking accuracy (Resolution) & processing error.

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[4] Dirk Bucchol et al. "Efficient Bin-Picking and Grasp Planning Based on Depth Data" IEEE International conference on Robotics & Automation ICRA-2013.