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SLAM Modelling and Object Detection for Mobile Robot with HoloLens

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ABSTRACT

This project shows an innovative application of augmented reality device, Microsoft HoloLens in Simultaneous Localization and Mapping (SLAM) based on computer vision deep learning algorithm for a developed object recognition and obstacle detection task. The most important objective of this implementation is to enhance SLAM modelling by Microsoft HoloLens and detect objects and obstacles through deep learning algorithm named YOLO (You Only Look Once). This system helps the robot to use HoloLens to detect and recognize the obstacles in indoor maneuver. For the object detection, the single forward propagation convolutional neural networks (YOLO) algorithm with three different versions are performed and compared.

INTRODUCTION

To navigate an autonomous robot in an unknown environment, localization is necessary to know where the robot is. Mapping is the structure of environment's map, knowing the right pathway of the robot [1]. in an unknown environment for autonomous robot, SLAM (Simultaneous Localization and Mapping) is essential for navigation [2]. Nowadays with advanced technologies for augmented reality (AR) such as Microsoft HoloLens, it can visualize, recognize, and detect, the objects in front of the user or the Robot. The modern deep learning algorithms such as Convolutional Neural Network (CNN) [3], Region-based CNN (R-CNN) [4], fast R-CNN [5], and You Only Look Once (YOLO) [6] can be implemented in Microsoft HoloLens for object and obstacle detection, and it enables the robot to identify objects and obstacles in AR area.

METHODOLOGY

Methodology of the system is shown in Fig.1 to make sure proper object and obstacle detection via HoloLens with YOLO. The software architecture is based on server-client connection. The hardware used are, two parallel NVIDIA GPU (graphic processing Units) Quadro P-4000 to run on the server which process the YOLO algorithm. HoloLens v1 and its built-on cameras are used as an input scene for object detection in the environment in the client side.

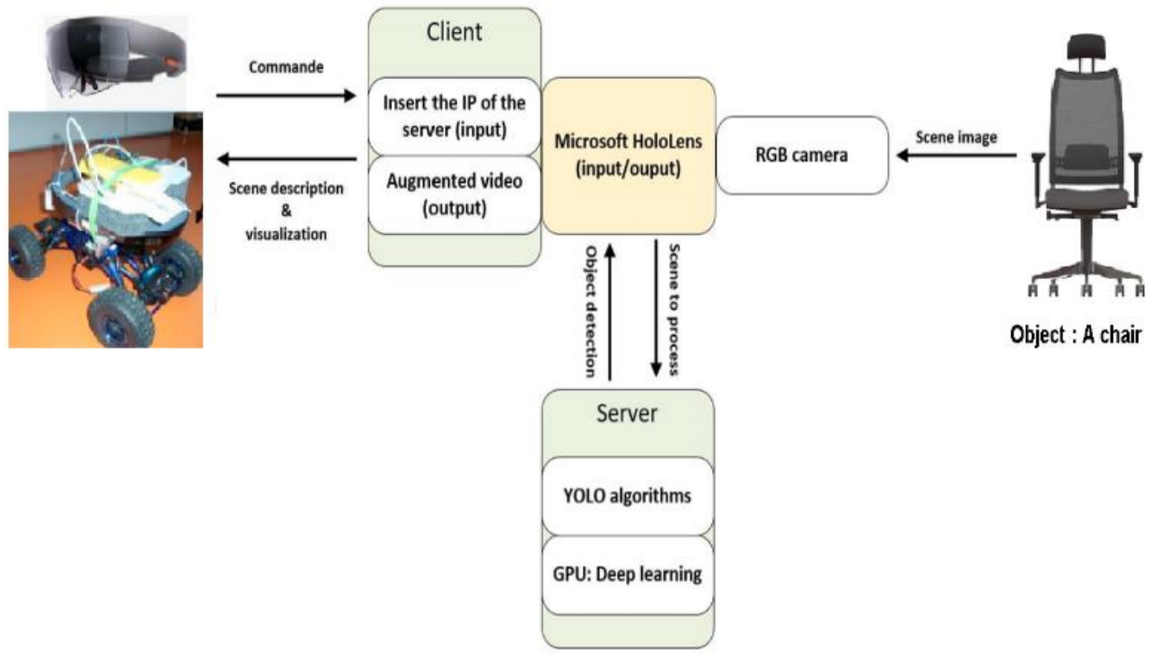

Fig.1: Architecture of the system

RESULTS AND DISCUSSIONS

YOLO v1, YOLO v2 and YOLO v3 are used to obtain the results in term of processing time and precision mean average. As shown in Fig.2, The findings show the effectiveness of YOLO for the precision average of various objects in our workplace. Based on the results, YOLO v3 gave a good precision detection which is higher than 90%.

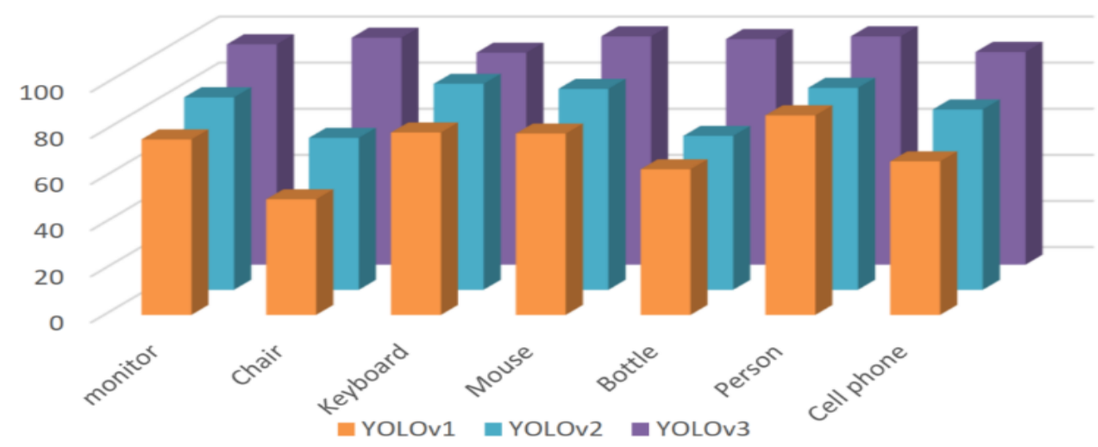

Fig.2: precision with respect to different detected objects by different YOLO versions

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