The discussion of disadvantages of recent robot learning methods and possible solutions

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Abstract. Nowadays, robots have been greatly developed by scientists and robotic experts, especially these operating and coding methods. They are now an important part of the whole society, providing much productivity for human being. However, there are also some obstacles that have not been fully overcome, including unsatisfying database quality, ineffectiveness of AI self-learning, etc. These problems can be categorized into two types: the kinematic problems and AI's problems. The former includes difficulties in calculations and singularity points, and the latter includes AI's lack of some certain types of abilities. This essay will focus on some of these obstacles that most robotics industry practitioner and experts are facing, and figuring whether there are some possible solutions. This essay will firstly introduce a strawberry harvester robot project that I've participated in and been responsible for its coding works and operating method construction, discuss some of its disadvantages, and then lead to the discussion of common problems across the industry. These problems can be categorized into two types: the kinematic problems and AI's problems. The former includes difficulties in calculations and singularity points, and the latter includes AI's lack of some certain types of abilities.

1 Introduction

Before discussing about some common problems, this essay will first introduce a strawberry harvester robot. It will include its structure, motivation, target detecting method, codes, and so on. The robot has four wheels. Formulas are made in order to enable the robot to calculate its route and reach its targets. YOLO-11 model is carried on a central computer, since it requires high computing power. Robots are connected to the central computer. They will send real-time images captured by their camaras to the central computer. The central computer will then pick the targets out, depending on its trained AI image recognizing model. It will also do calculations and guide the robots to reach their own targets. In this process, how to train the AI image recognizing model is probably one of the most important parts. This robot uses object detection to find out its target. Object detection is a fundamental computer vision task that can support a wide range of downstream tasks [1]. One-stage means that the robot will directly detect its target in the input image. For instance, a robot is given an image, and it's asked to search for a cat in the image. If the robot uses one-stage detection, it will directly

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start to look for the cat in the image based on the image of "cat" in its database. After locating its target, it will use a frame to segment its target out of the background. In contrast, two-stage detection means that it will firstly analyze and select the possible regions that the cat may exist, and then try to detect the cat in the selected regions. The strawberry harvester uses one-stage detection method mainly because one-stage detection runs faster, especially when the robot needs to do real-time calculations, while two-stage detection is more accurate than one-stage. YOLO 11 detection model, which is responsible for recognize the target and locate it, is loaded on the central computer. Data training is the first step of training a satisfying model. Data are provided, and AI will learn from the given data. The next step is evaluation, which means that the result model will be checked and evaluated, in order to ensure its efficiency and accuracy. Then, it will be used in real-life situations, to make sure that it is able to operate properly in actual use. This is the inference step.

Although these theories seem complete and well developed, some obstacles and difficulties still exist. Some of these difficulties are caused by the developing environment, including short development period, lack of material and hands-on experience, calculation mistakes, etc. For example, we failed to make a simulation of the harvester. We didn't have enough materials to assemble a real model. These problems are troubling, but they are not caused by the robot or AI itself. There are also some scientists and experts concerning that the development of robots and AI might bring unstable issues to the human society, including taking place of human workers and using AI to create fake news, articles and images. These problems won't be discussed as well, since these concerns are caused by the lack of constraints on the use of robots and AI. They actually kind of illustrate that AI and robots are so well developed and powerful that can even threat to human society. However, some problems, we found, are still unsolved or hard to overcome for many other robotics practitioners. These problems exist in robots and AI, and they are this essay's focus.

2 Key obstacles

2.1 mechanics problems

One of the most serious mechanics problems might be the singularities. Control mechanisms that rely on computation of an inverse or generalized inverse of a Jacobian are likely to breakdown near a singularity; associated to this may be unbounded joint accelerations and torques.

Even when it is possible to avoid singularities, their presence can result in lack of repeatability [2]. At the singularity points, the robot movement will suddenly change. For example, for a robot arm, its initial state is folded. When it is simulated to stretch out and then draw back, a singularity point will exist when it is fully stretched out. This is because at that point, the mechanism arm will have two ways to draw back: folding up or down. Therefore, the computer will be confused. It doesn't know how to fold the arm back. Thus, the arm will twitch at that point. If this problem isn't solved and the robot is manufactured and put into use, it can profoundly affect the performance and control of the manipulator, variously resulting in intolerable torques or forces on the links, loss of stiffness or compliance, and breakdown of control algorithms [3]. Singularity points exist in 4 and 6 degree of freedom robot manipulators. Degrees of freedom (dof) are the number of values in a distribution that are free to vary for any particular statistic [4].

This leads to a second problem. Robot computer uses Forward Kinematics Analysis (FKA) and Inverse Kinematics Analysis (IKA), which means that using joint displacements to compute the final location of end effector and using the position of end effector to calculate the joint displacements, respectively, to simulate its movement or control the joint. However,

these computations will usually get different results. In the strawberry harvester project, the robot needs to choose one route out of different routes of accessing its target. This greatly increase robot practitioners and programmers' workload, and it also lowers robots' operating efficiency.

2.2 AI learning obstacles

To train a satisfying ai model, huge amounts of data are necessary. However, it is hard for us to make sure that all data is accurate, effective and unpolluted. AI may come up with conclusions that are based on fake information. These conclusions will be misleading and inaccurate. In the strawberry harvester project, an ai strawberry detecting model is trained. With the help of YOLO11 model, it isn't hard for us to train the ai with data. The most difficult thing is to make sure that all data (in this case, images) are clear and easy to recognize. The strawberries in the input images have to be clear and easy to recognize. Their shapes and outlines should also remain visible. That ensures the efficiency of ai model training and learning. This really takes a lot of time. In order to train algorithms to classify data or predict outcomes accuracy, supervised learning is used. In Supervised, attempts are done to find the relationship between the independent variables and the dependent variables [5]. In other words, every model has a single target, and supervised learning's mission is to train a model that can classify the objects in an image. In this case, a model is trained by using supervised learning in order to have the ability to classify and recognize strawberries in the given images captured by the robot's sensors and camaras. In conclusion, recently in the robotic industry, the lack of clear standard of data quality is causing huge obstacles. Considerable amounts of resources have been wasted in order to ensure the purity of input data before training a satisfying model. Finding an accurate, clear and proper standard is the primary mission.

Another difficulty is that AI doesn't have imaginative. Which is to say, although given enough high-quality data as training materials, AI may still have difficulties in recognizing incomplete targets. This is noticed when trying to operate the strawberry harvester in practical situations. The robot seems to have great trouble in locating strawberries that are cover by leaves or shadows. A normal person will definitely tell that it's a strawberry when seeing its red color and round shape even if it is partly covered by leaves. He will then imagine the rest part of the strawberry and know where to pick it. However, AI is not able to notice these noticeable characteristics by itself. Current AI systems are "narrow" specialists that excel in well-defined problems but struggle with general situations requiring common sense, creativity, or emotional understanding [6].

In addition, AI isn't good at understanding the conversation's context. AI is trained on very large amounts of text data, hence identifying patterns and making predictions on data. This also makes AI exceptional at improving existing code or content and even correcting grammar, but it still lacks an understanding of the nuances of human language and communication [7]. Actually, since it is almost impossible to use digital data (0 and 1) to express human's feelings and emotions and other abstract concepts, human being will keep this advantage over AI for a long time.

3 Possible solutions

3.1 mechanic problems' solutions

Since singularity points only exist in six DOF systems, an easy way to avoid these points is to lower a robot's DOF. In other words, make its structure simpler. Lower DOF robots can do a lot of works as well. In fact, there are many industrial tasks such as welding and many

other tasks like milling, deburring, laser-cutting and gluing, that require less than six-DOF [8]. When a robot has to be kept six DOF, scientists will use Jacobian to calculate the singularities, which includes their locations (when exist) and other properties. Some scientists managed to figure out solutions of some normal properties, but they recognized that the special form of forward kinematic mappings for serial manipulators imposes significant restrictions on the applicability of so-called genericity results.[2]

3.2 AI learning and operating solutions

In the previous chapters, the low quality of data input is creating considerable obstacles to AI model training. Without people's monitor, AI isn't able to identify whether some data is "high quality" or not. Thus, human can set some standards to help AI to distinguish low quality data by itself. For instance, when training a strawberry detector, only images with a certain resolution will be accepted. This can ensure the clarity of images, which helps the robot to recognize its targets more accurately. The standard may vary in different situations, but making proper standards is necessary. That will obviously improve AI learning's efficiency.

The lack of imagination might remain unsolved for a long time. Emotion and imagination are the most important characteristic of human beings. They are evolved during the long evolution that lasts for millions of years. The attempt of mimicking these functions by using artificial intelligence is still at a beginning stage. As digital machines they are equipped with a completely different operating system (digital vs biological) and with correspondingly different cognitive qualities and abilities than biological creatures, like humans and other animals [9]. Further studies are required to overcome this obstacle.

4 Conclusion

Obstacles in the robotics and AI fields includes singularity points that are risky for machine operation, huge amount of calculation required when doing FKA and IKA and planning a robot's movement, variation in data quality and differences of the principles of intelligence generation between humans and AI. Possible solutions are, respectively, lower robot's DOF or Jacobian matrix, using simpler formulas, setting proper standard of data quality and let AI to filter out poor quality data, and doing further studies. There is no doubt that the robot and AI will greatly benefit people's lives. Although still having these obstacles, the future of robotics industry is bright. It is continuously developing with the support of experts and researchers. Thanks to their studies and researches, the success of robots and AI is foreseeable.

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