Implementation of Pet Detection and Recognition on the NVIDI A Jetson Nano

1st Cox, Jason
The Governor's School for Science and Technology (of Aff.)
Hampton, United States
jason.cox@nhrec.org

2nd Chestnut, William
The Governor's School for Science and Technology
Hampton, United States
william.chestnut@nhrec.org

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I. Introduction

The NVIDIA Jetson is an embedded AI computing platform focused on combining low-power with speed and accuracy. Because of the reductions in cost, weight, and power consumption, the embedded nature of devices like these allow for developments such as autonomous navigation, with Visual Simultaneous Localization and Mapping, or vision-based depth reconstruction on mobile platforms like exploration vehicles with attached computers. These devices additionally make artificial intelligence more accessible to the common person. While not perfect, as this technology has much room for improvement, the Jetson allows for developers to create machine learning applications on a small scale without requiring a lot of power or cost, while still remaining effective and efficient. These developments have and will continue to have impacts in the fields of manufacturing, robotics, security, and customer experiences.

II. Literature Review

This section will cover recent academic discoveries around the NVIDIA Jetson as well as relevant problem spaces where embedded systems are commonly

A. Overview of Machine Learning on NVIDIA Jetson

Designing hardware accelerators for neural networks or other machine learning applications involves a very precarious balance between constraints of low-power and high accuracy and throughput. (Mittal, 2019) The goal of the NVIDIA Jetson is to meet the above objectives and contribute to the developing interest in fields such as image processing, natural language processing, data analytics etc. The study from Halawa et al. characterizes the Jetson and concludes that the asymmetric nature of the CPU and GPU as well as the frequency balance point allow the developer to optimize performance while ensuring energy efficient computing. (Halawa et al., 2017) Making a device like the Jetson which can be so easily implemented into daily life encourages making artificial intelligence a part of the life of every person. The survey from Mittal explains numerous real-life implementations of the Jetson and highlights the goal of "AI for all".

B. SLAM Methods on Rovers with NVIDIA Jetson

Exploration vehicles such as those used on missions to Mars need accurate localization and autonomous navigation in order to be effective. (Giubilato et al., 2019) The first mission to Mars implemented wheel odometry, in which motion sensors were used to determine the robot's change in position, such as counting the number of wheel revolutions. However, due to rover wheels slipping in the sand, this method was highly inaccurate and a more effective way of measuring motion was required. This method was found in visual odometry, or more specifically, SLAM (Simultaneous Localization and Mapping). SLAM is essentially an application of machine learning in which the computer simultaneously builds a map and localizes a robot within it.

This technology is now being implemented via embedded computers such as the NVIDIA Jetson. The paper from Giubilato et al. reviewed the effectiveness and implementation of the Jetson on a ground rover using SLAM methods. Their evaluation showed the viability of the Jetson in this environment and provided a novel benchmark for visual SLAM algorithms on embedded computing platforms. The NVIDIA Jetson enables technologies like this and continues to make artificial intelligence more applicable and possible in real-world scenarios.

C. Vision-based Depth Reconstruction

Another example of the use of the NVIDIA Jetson is within vision-based depth reconstruction, a challenging problem that has been extensively studied in computer science. (Bokovoy et al., 2019) This technology deals with being able to judge depth from a single image. Sensors that can provide range measurements are usually expensive, large, heavy, and power hungry. The study from Bokovoy et al. attempts to use the NVIDIA Jetson to solve these problems as it is inherently built to be the opposite of those qualifications. This analysis uses fully convolutional neural networks (FCNNs) in order to evaluate depth in real time using both a PC And the NVIDIA Jetson. They demonstrated that the models proposed were able to run effectively in real-time with state-of-the-art accuracy, once again establishing the Jetson as a viable way to easily and cheaply use artificial intelligence to solve problems in growing fields of mobile robotics, augmented reality, computer aided design etc.

D. Stereo Visual Implementation on NVIDIA Jetson

Embedded computing platforms have also demonstrated their place in real-time stereo vision systems. Stereo based 3-dimensional construction of a scene from an image has been studied in the past but most of these algorithms have extreme execution times, even on the most powerful computers. (Cui Dahnoun, 2019) The paper from Cui and Dahnoun demonstrates that a high power consumption processor would not work for autonomous applications of stereo vision, however, they show how an NVIDIA Jetson can be used to reduce computation cost and improve output quality. With their implementation, the paper concludes that the Jetson can reach performance faster than real-time requirements. The Jetson fills the gap of a low-power, low-cost, lightweight, and fast processor that can solve problems from location mapping, to depth measurement and 3D reconstruction.

E. Conclusion

These examples of implementations of the NVIDIA Jetson provide approaches to different problems that all revolve around a common necessity. A device that can be low-power and cost but highly effective. Embedded AI platforms make machine learning and artificial intelligence accessible in more fields of everyday life and having a device that can be used so flexibly expands the possibilities in AI.

REFERENCES

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REFERENCES

[1] Bokovoy, A., Muravyev, K., Yakovlev, K. (2019). Real-time vision-based depth reconstruction with Nvidia Jetson. 2019 European Conference on Mobile Robots (ECMR). https://doi.org/10.1109/ecmr.2019.8870936

[2] J.Cui, H., Dahnoun, N. (2019). Real-time Stereo Vision Implementation on nvidia jetson TX2. 2019 8th Mediterranean Conference on Embedded Computing (MECO). https://doi.org/10.1109/meco.2019.8760027

[3] Giubilato, R., Chiodini, S., Pertile, M., Debei, S. (2019). An evaluation of ROS-compatible stereo visual slam methods on a Nvidia Jetson TX2. Measurement, 140, 161–170. https://doi.org/10.1016/j.measurement.2019.03.038

[4] Halawa, H., Abdelhafez, H. A., Boktor, A., Ripeanu, M. (2017). Nvidia Jetson Platform Characterization. Lecture Notes in Computer Science, 92–105. https://doi.org/10.1007/978-3-319-64203-1-7

[5] Mittal, S. (2019). A survey on optimized implementation of deep learning models on the Nvidia Jetson Platform. Journal of Systems Architecture, 97, 428–442. https://doi.org/10.1016/j.sysarc.2019.01.011