

# Decentralized Smart Traffic Framework Based on MPI-based Clusters of Autonomous Vehicles

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## INTRODUCTION

### BACKGROUND

**Smart Traffic** has become more and more feasible under the advancement of **Autonomous Vehicles (AVs)** and the **Internet of Things (IoT)**. To optimize traffic congestion, researchers invest a lot of effort into developing **data transfer protocols** and frameworks to put AVs and IoT together for use.

### MOTIVES

What are the existing problems?

Most data transfer protocols nowadays are **centralized**, meaning that the vehicles rely on a centralized system or a centralized node, such as Cloud and Smart Lamppost, for traffic control. With the increasing number of AVs, those centralized systems are required to have a high computation power, which comes with a **high computation** and **maintenance cost**.

What are we trying to achieve?

Propose a framework that resolves these issues by distributing the computational task to a cluster of edge devices through **Message Passing Interface (MPI)** protocols, achieving network decentralization. This framework ensures **low-latency** communications between nodes and **low computation time** through parallel computing.

## PROPOSED SOLUTION

### DECENTRALIZED

Making a node to be the **HOST** and **SLAVE** at the same time. (Inspired by **Blockchain**)

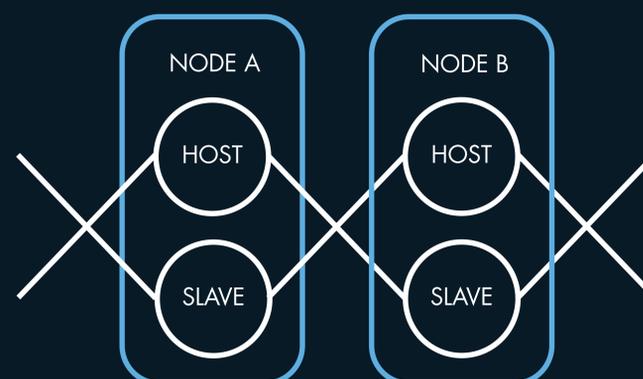


FIGURE 1: Decentralized Network

### MPI IMPLEMENTATION

The **HOST** will initiate the receiving protocol built within the **SLAVE** when it sends the commands.

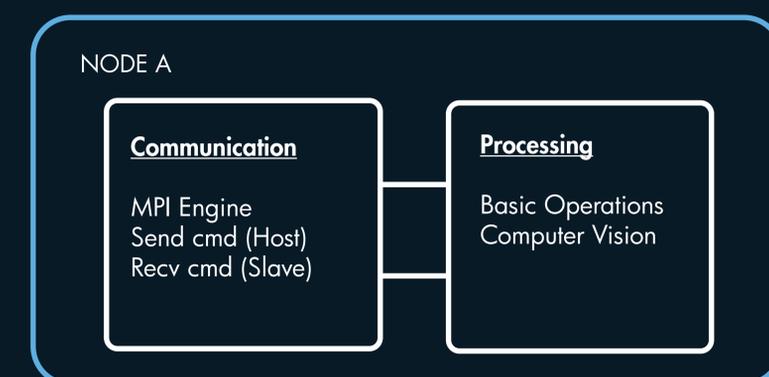


FIGURE 2: Engine Architecture

## MATERIALS



Small Scale Implementation:  
Waveshare JetBot with Nvidia  
Jetson Nano Card (As the AVs)

## RESULTS & DISCUSSION

### RESULTS

The concept is **implemented, proven, and tested**. The MPI Engine can be implemented in the edge devices to achieve decentralization.

### FUTURE DIRECTION

E.g. Establish **parallel training** in edge devices.

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