ABHIYAAN

TEAM REPORT ROUND 1 - INDY AUTONOMOUS CHALLENGE

Feb 28th 2020

ABOUT TEAM

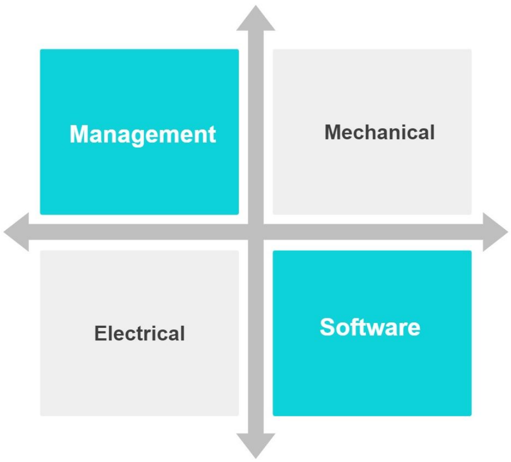
Team Abhiyaan is a competition team of IIT Madras under the Centre For Innovation (CFI). We are a group of 25 enthusiastic students from Graduate, Under Graduate courses of IIT Madras, who wanted to use and build an autonomous, intelligent, robust, precise and safe ground navigation systems to negate human risk and error in any platform. We recruit interested and technically sound students of our institute to our team. Our Faculty Advisor is Prof. Sathyan Centre For Innovation(CFI) is the Student Innovation Lab/Hub of IIT Madras.

TEAM HISTORY

We take part in a competition named IGVC (Intelligent Ground Vehicle Competition), held every year in Michigan, USA. The **Intelligent Ground Vehicle Competition** (IGVC) is an annual international robotics competition for teams of undergraduate and graduate students. Teams design and build an autonomous ground vehicle capable of completing several difficult challenges.

Our beloved team was conceptualised by the IITM alumni in 2014 and we started to participate in the competition in 2016. It was indeed a rough start for us. We had our own ups and downs but we didn't let it consume us. We like to face various challenges and we believe that in the process we reach higher peaks.

In 2017, we were placed 13th overall out of many teams across the globe in IGVC. 2018 saw us being placed, as 10th overall in the competition. In 2019, we are proud to announce that we were placed as the 1st runner up out of the many teams.
Please click here for the video of bot's performance and here for a few photos.

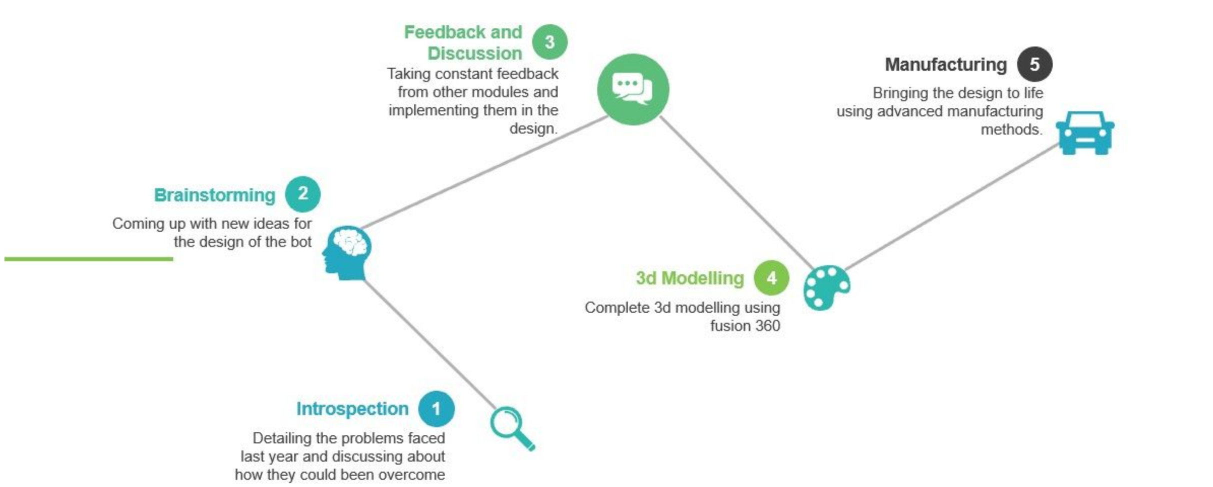


TEAM ORGANIZATION

We are a team of multi disciplinary students Committed towards building autonomous, intelligent, robust, precise and safe ground navigation systems.

Mechanical - Returns the Robust and Stable framework and mechanical structure.
Electrical - Returns Circuit designing to control input from Perception sensors and control output Actuators

Software - Returns an efficient program & algorithm that gathers data from all available feed backs and sensor values and outputs the required control
Management - Responsible for Sponsorship,Marketing and PR of the team.

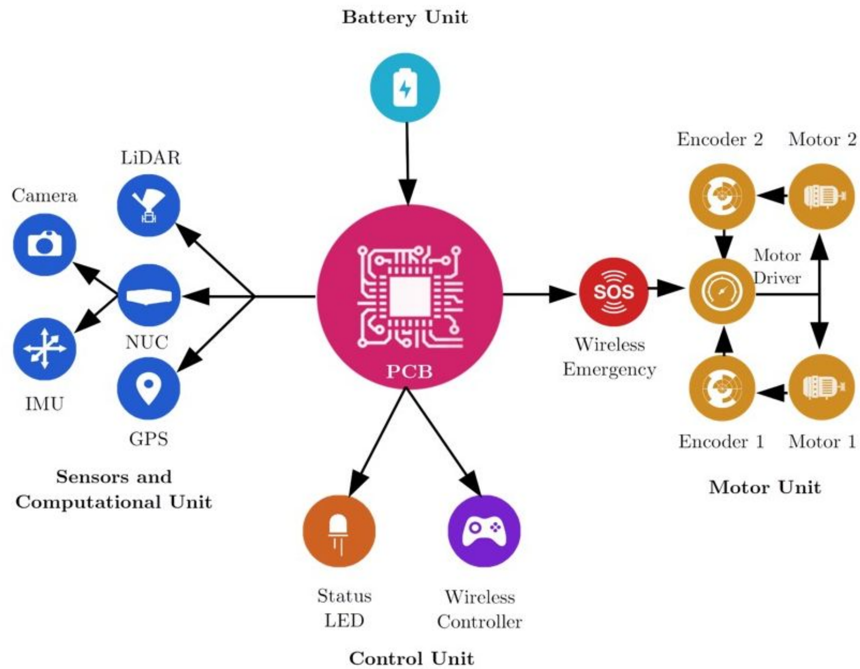


We work on a spiral gate model with continuous feedback checks from all modules.

OUR HISTORY WITH AUTOMATION

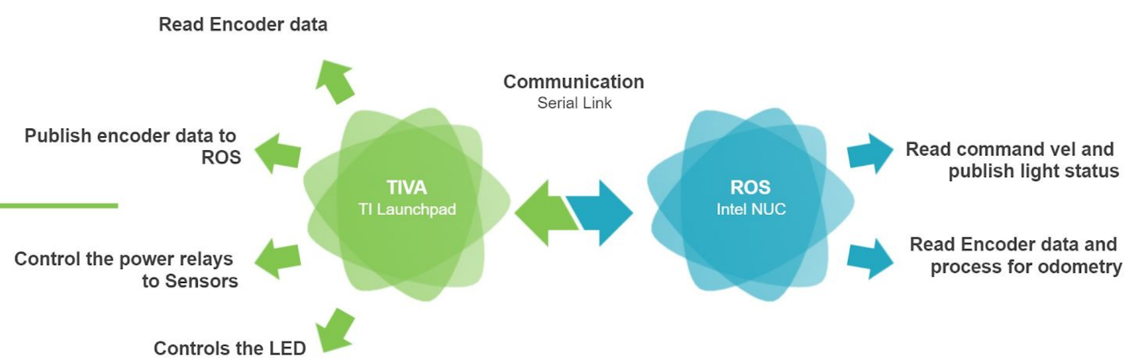
Our experience in the field of autonomous drive comes solely from participation in **Intelligent Ground Vehicle Competition** (IGVC), for which we designed a fully functional autonomous navigation ground robot which is capable of navigating between two GPS waypoints of an unknown Lane obstacle course.

Control Map of our Ground Robot



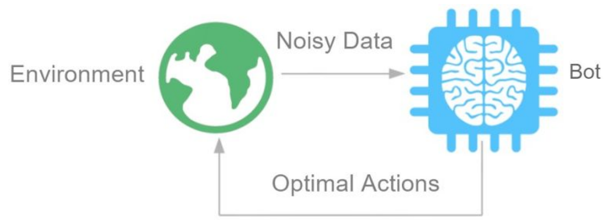
Software - Actuator Bridge

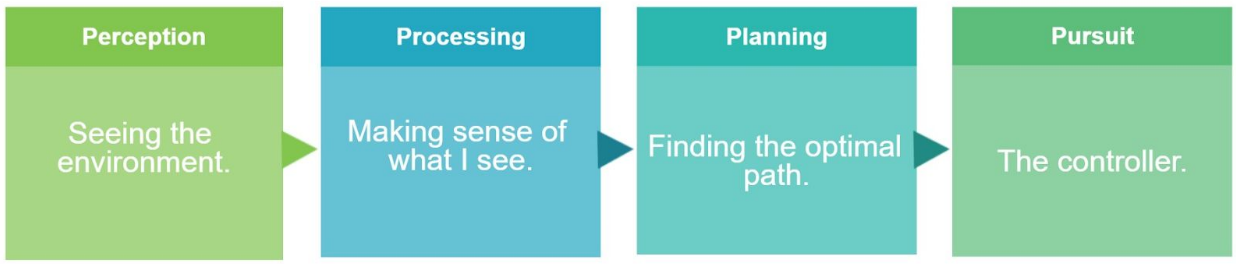
The communication link which is responsible to Output the Actuator Control



We develop the Software end using Robot Operating System (ROS Kinetic). ROS is responsible of communication of data between nodes.Multiple ROS packages are used to gather,simulate percepted data and path planners such as RRT, RRT* and A*.

Software Architecture

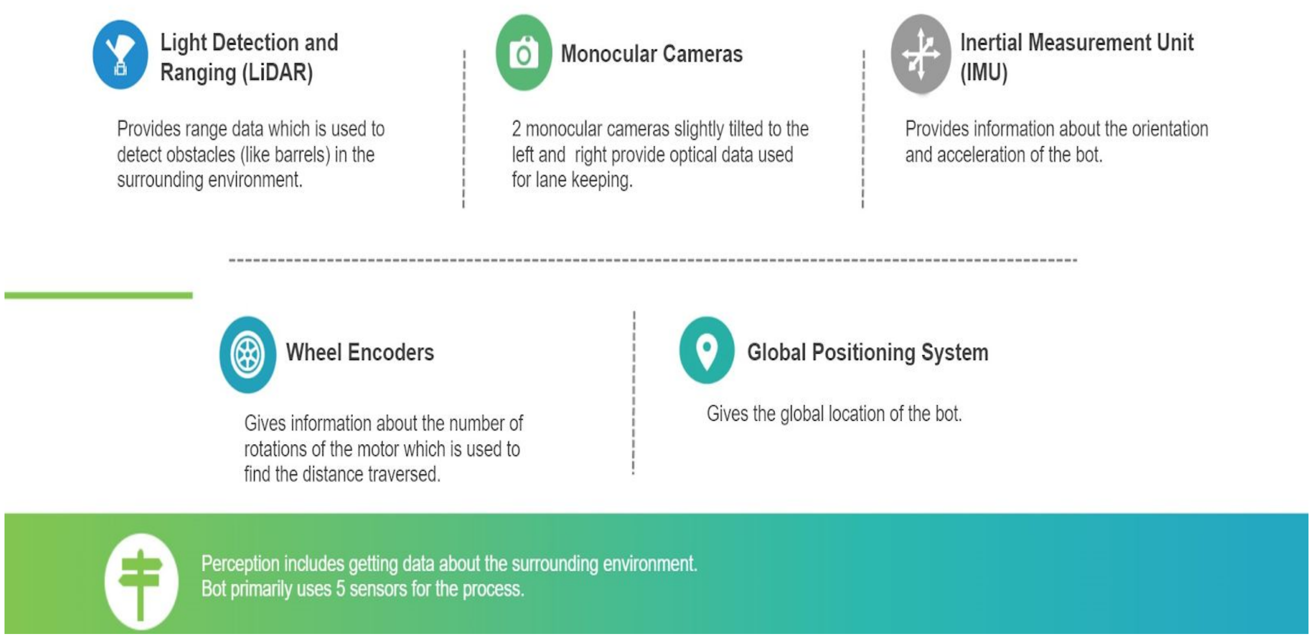




The complete software architecture used can be classified as into these sub sections

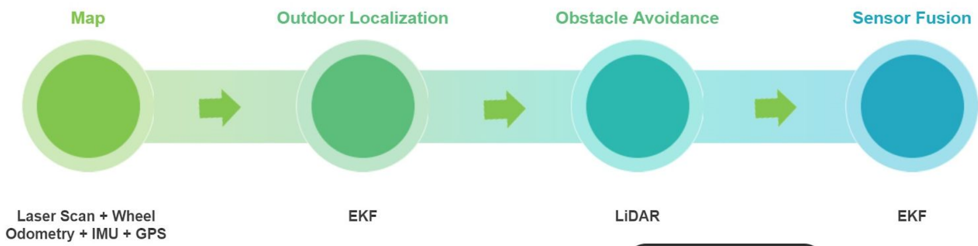
- **Perception**
- **Processing**
- **Planning**
- **Pursuit**

Perception

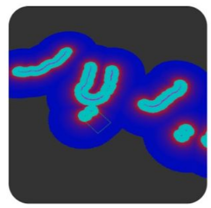


Processing

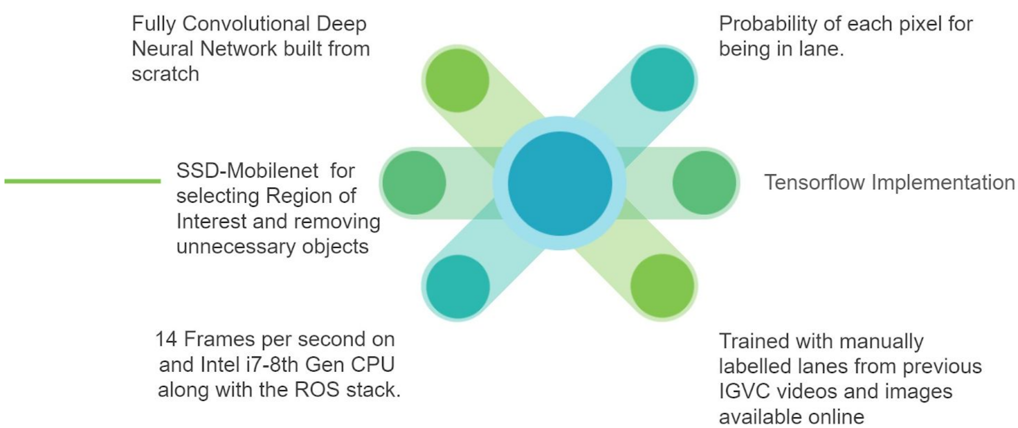
- **Mapping**



- Occupancy grid is constructed using the obstacle avoidance data given by LiDAR
- A 2D cost-map is created, in 2 layers – Local and Global
- Map is then used for path planning



- **Lane Detection**



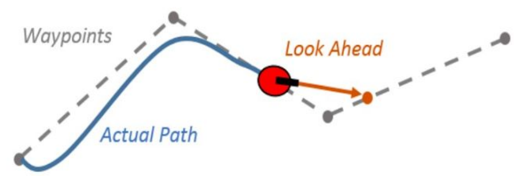
Planning

- Finds shortest path by expanding vertices in graph starting with the initial pose.
- Expands unexpanded vertices with the lowest cost.
- Cost includes distance from current vertex along with a heuristic cost.
- The heuristic cost is the distance to the goal.

- RRT samples a random set of points and adds an edge to the closest point towards the goal.
- RRT* Informed intelligently chooses a subset of the search space to sample its points.
- RRT* Informed thus converges faster whilst finding the shortest path.

Pursuit

- The controller gives appropriate control inputs to the robot to ensure the planned path is followed.
- The controller takes a look ahead goal at a fixed distance at every instant of time, similar to how humans drive
- A curvilinear trajectory to the immediate goal is generated
- The velocity is then obtained from this trajectory and kinematics



PLAN FOR INDY AUTONOMOUS CHALLENGE

Round 2

We are currently procuring a two seater electric golf cart (RT-G-A2 - DC motor Electric Golf Cart by Roots Electric Vehicles) for developing it into a Level 2 SAE Standard of Autonomy. Drive by Wire systems, Sensor Fusion and Feedback systems for automation of golf cart are currently in the planning phase. We are looking for In-Kind Sponsors and closed deals with few of them.
The Management Module of our Team fetch sponsors and connects to elevate our growth. We are looking for sponsorship prospects and it would be a great help if we are supported with connects to whom we can approach.
Certain alterations in software architecture and algorithms such as packages for differential drive are in the Initial Development Phases.Added to this we have successfully developed an autonomous ground bot as mentioned before.
We are looking forward to having a memorable and valuable venture in the Indy Autonomous Challenge and We thank ESN for providing platforms to introduce University Students to Real Time autonomous technologies and frameworks.

TEAM MEMBERS - Indy Autonomous Challenge (All are Students of IIT Madras)
Aakash A - 2nd Year,Engineering Design
Manoranjan J - 3rd Year, Naval Architecture and Ocean Engineering
Harish Iniyarajan - 2nd Year, Chemical Engineering
Aditya Balachander - 2nd Year, Electrical Engineering
Abhijeet AjithKumar - 2nd Year, Electrical Engineering
Abhigyan Chattopadhyay - 1st Year, Electrical Engineering
Rajdeep Thakur - 1st Year, Chemical Engineering
Amit Dodmani - Phd Student Mechanical Engineering
Vivek Sharma - 1st Year, Ms Mechanical Engineering
Aman Sahore - 2nd Year, Electrical Engineering