



Statement of Work No. **RBEI/ESU/2019/KLETech001**

Project/Program Title: **Camera Assisted Localization for an autonomous vehicle**

**NO PROJECT SHALL BE CARRIED OUT WITHOUT BOTH PARTIES SIGNING THIS STATEMENT OF WORK**

This Statement of Work is entered between RBEI and Institute:

1. Institute Name ("Institute"): **KLE Technological University**

**Institute Address:** B. V. Bhoomaraddi Campus, Vidyanagar, Hubballi (India)

Institute's Project Manager: Dr Nalini C Iyer, Head, School of Electronics & Communication Engg

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and is effective from to defined ("**Commencement Date**").

RBEI and Institute enter into this Statement of Work (SoW) pursuant to the University Agreement dated **22<sup>nd</sup> October 2019** to jointly work on the Project on topics of mutual interest (the "**Agreement**"). Any terms not otherwise defined in this SoW shall have the meaning ascribed to it in the TNCA.

## 1. General Information

Description of the Project/Program: (a) Camera Assisted Localization for an autonomous vehicle

## 2. Milestone Schedule

**Project /Program Plan** (Detailed Project plan will be shared before executing the Agreement)

Milestones	Date
SoW Review and Kick-off	15/10/2019
System Architecture Freeze	01/11/2019
Pole Map Created	01/12/2019
Pole Map Delivery to RBEI	06/12/2019
Simulation Results Available	15/01/2020
Final Software Delivery	31/01/2020

### 3. Scope of Work

The localization is a key aspect for any autonomous vehicle. Without a localization, one would not be able to use map information for path planning, and instead be left to solely rely on sensor input, to figure out what the road ahead looks like.



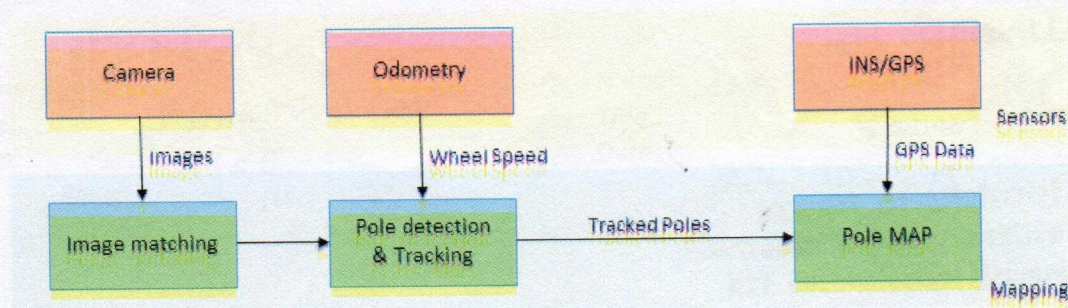
In an autonomous vehicle, global navigational satellite system (GNSS) like GPS, GLONAS et.. are used to locate the vehicle position. This is done by a process called trilateration which determines absolute or relative locations of points by measurement of distances using the geometry of circles, spheres or triangles (triangulation mechanism). But the GNSS measurements may have an error ranging from 1 to 6 meters. To minimize this error, a fusion of couple of sensor data is necessary along with the GNSS based positioning.

The scope of the project is to focus on the problem of localization of an autonomous vehicle without the expensive LiDAR sensors, which fulfils accuracy and reliability requirements for safe operation. The project has to establish a camera assisted localization required for an autonomous vehicle along with the GNSS. We propose the use of **pole-like landmarks** as primary features in these environments, as they are distinct, long-term stable and can be detected reliably with a camera system. Any other method apart from the use of pole-like landmarks can also be evaluated. Idea is to perform a localization in real time by a camera system using the vehicle odometry and the GNSS solution.

Intention is to achieve a localization in 2 step approach (based on [IEEE Paper](#))

- Creation of Pole Map (using sensors like Camera, Odometry and GPS)
- Adding geo-tags to the identified predominant poles
- Use this Map info to achieve localization using filters (Kalman)

#### 1. Creation of Pole Map (using sensors like Camera, Odometry and GPS)



The idea for global localization of vehicles is to use the local pole pattern and match this to the global set of poles



**4. Objectives of the Project**

1. Evaluate the possible options for the video assisted localization for an autonomous vehicle
2. Establish a camera based solution for localisation which can consistently maintain the error within 50cm
3. List the advantages and limitations of such a solution
4. Provide further analysis to overcome the limitations
5. Deliverables should be in the software/code format

**6. Fund/Cost**

**7. Additional Provisions**

IN WITNESS WHEREOF, the Parties hereto have executed this Scope of Work by their respective authorized representatives as of the Effective Date first set forth above.

**Robert Bosch Engineering and Business Solutions Private Limited**

**KLE Technological University , Hubballi**

Name:  
Title:  
Date:

*B. Mohan*  
**BELUR MOHAN**  
HEAD - HR → HR FUNCTION

22/10/19

Name:  
Title:  
Date:

*Prakash Varma*  
**PRAKASH VARMA**  
HOE

Name:  
Title:  
Date:

*Ashok Shettar*  
**Dr. Ashok Shettar**  
Vice Chancellor  
22-10-2019

**VICE CHANCELLOR**  
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Head, School of Electronics & Communication Engg  
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