Final Year Project Showcase Batch 2018
Year 2022

Department: Electronics Engineering Program: Electronics Engineering		
1	**Project Idea**	Three-dimensional vehicle trajectory estimation using IMU-based sensing for self-driving cars.
2	**Process**	The acceleration data of the vehicle is retrieved using the Inertial Measurement Unit or IMU sensor along with the interfacing of Arduino nano. The data is then filtered by applying filtering algorithms to get meaningful data. The design of the algorithm and filtering of raw data was done by using the python programming language.
3	**Outcome**	Hardware that is capable of tracing a complete route in real-time and estimating the distance covered by the vehicle.
4	**Evidence (Theoretical Basis)**	The distance estimation and trajectory plotting of self-driving vehicles are the main objectives of this project. The MEMS 9-axis IMU sensor interfaced with MCU (Arduino Nano) is used for distance estimation. The three-axis accelerometer, gyroscope, and magnetometer of this sensor allow it to monitor the magnetic field, angular velocity, and acceleration in three dimensions. It is calibrated correctly to prevent errors caused by incorrect sensor measurements. The accelerometer is the primary sensor used in distance estimation. It gives two types of acceleration, acceleration with gravity or linear acceleration. For distance estimation, linear acceleration is used to overcome the errors caused by gravitational force. The linear acceleration is integrated twice with respect to time to find the distance of a moving object. In an analytical integration, there is a drift integration errors accumulate over time therefore, numerical integration is used to get the best possible results. The main issue with the accelerometer is vibrational noise because it measures the force exerted on a suspended mass. If the sensor is at rest or subjected to any jolt, it continuously measures some force that will cause distance errors, called offset errors of the sensor. These errors are filtered out to get the best possible estimated results. The results are plotted in real-time to determine the trajectory and distance of the vehicle.
5	**Impact on Sustainability of Urban Regions or SDG-11 "Sustainable Cities and Communities"**	Vehicle localization in the autonomous ground can impact the fields of advanced vehicle safety systems and intelligent transportation systems. . Some of the possible benefits would be the reduction of traffic accidents, better driver convenience, optimized traffic flow, and expeditious driving. It can also ensure the safety of vehicles. In case of an emergency, it will help to locate the vehicles and show the exact location from where a distress signal was received.

6	**Competitive Advantage or Unique Selling Proposition**	
A	**Cost Reduction of Existing Product**	The estimated cost of this product is approximately around 30 to 35 thousand PKR.
B	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** (e.g. What is the issue in the current process and what improvement you suggest)	Currently, this hardware is only able to give the relative position of the vehicle and not the global position. In the future, GPS sensors can be added and fused with Imu to get both the global and relative positions that will help in operating fully autonomous vehicles.
C	**Expanding of Market share** (e.g. how it expand and what is the problem with the current market	Currently, vehicle localization involves using Global Positioning System (GPS) signals. GPS provides absolute position information with reliability within a few meters. However, GPS requires a clear line of sight to satellites because GPS signals are vulnerable to visual obstacles and signal reflections. The dense mediums and bad weather conditions distort the GPS signal. In contrast, IMU signals are independent of climate changes and other natural conditions. They are less affected by visual obstacles or weather conditions and well- reflect the response of the vehicle to excitations from the surrounding environment.
D	**Capture New Market** (e.g. Niche market or unaddressed segment)	The increase in demand for autonomous vehicles is expected to increase the market growth of the autonomous vehicles industry in upcoming years and IMU-based vehicle localization will dominate in this market.
7	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service	The primary target market is the autonomous vehicle industry and the industries that rely on inertial navigation systems.
8	**Team Members** (Names along with email address	Yusra Imran (imran4102050@cloud.neduet.edu .pk) Javeria Bint Haziq (haziq4101050@cloud.neduet.edu .pk) Sania Nadeem (nadeem4107223@cloud.neduet.edu .pk)
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10	**Pictures (If any)**