Agnel Charities'

Fr. C. Rodrigues Institute of Technology, Vashi

Department of Mechanical Engineering

MECHANICAL ENGINEERING STUDENTS' ASSOCIATION

Presents

URJA

2017-18

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Fr. C. Rodrigues Institute of Technology, Vashi

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URJA

(2017-2018)

Mechatronics

INSTITUTE PROFILE

F.C.R.I.T. was established in 1994 and is a part of the Agnel Technical Education Complex at Vashi, which itself was established in 1984. The institute is named after late Rev. Fr. Conceicao Rodrigues. F.C.R.I.T. persistently seeks and adopts innovative methods to improve the quality of education on a consistent basis. The campus has a cosmopolitan atmosphere with students from all corners of the country. Experienced and learned teachers are strongly encouraged to nurture the students. The global standards set at F.C.R.I.T. in the field of teaching spurs the students in relentless pursuit of excellence. In fact, it has become a way of life for all at the institute. The highly motivated youngsters on the campus are a constant source of pride.

F.C.R.I.T. has, within a short span of time, established itself as a leading engineering college in Mumbai University. Though its reputation rests mainly on the high quality, value-based technical education that it imparts, it has to its credit a verdant, well-maintained Campus and extensive facilities. Its location in the vicinity of the holy places of various religious denominations underscores its secular credentials and its philosophy of **"Vasudhaiva Kuttumbakam"**.

INSTITUTE VISION

To evolve and flourish as a progressive center for modern technical education, stirring in every student's creativity leading to self-sustainable professional through holistic development, nurtured by strength and legitimate pride of Indian values and ethics.

INSTITUTE MISSION

- To provide industry-oriented quality education.
- To provide holistic environment for overall personal development.
- To foster relationship with other institute of repute, alumni and industry.

MECHANICAL ENGINEERING DEPARTMENT VISION:

To provide a vibrant academic, research and industrial environment for creating self-sustainable professionals and responsible citizens.

MECHANICAL ENGINEERING DEPARTMENT MISSION:

- To provide state-of-the-art infrastructure and quality education.
- To generate opportunities for students to provide Industrial Exposure.
- To imbibe team spirit and entrepreneurial skills.

PROGRAM EDUCATIONAL OBJECTIVES (PEO):

Graduates will...

- Be able to use effectively engineering knowledge and modern tools in the field of core Mechanical Engineering.
- Have interdisciplinary competence in areas like Mechatronics and CAD/CAM/CAE.
- Be able to demonstrate adequate competency and creativity to take up corporate challenges.
- Be able to pursue higher studies and entrepreneurship.

PROGRAM SPECIFIC OUTCOMES (PSO):

Graduates will be able to...

- Apply knowledge in the domain of Design, Thermal and Manufacturing sciences to solve Engineering Problems.
- Use appropriate tools and techniques to solve problems in the field of Mechanical Vibration and CAD/CAM/CAE.

PRINCIPAL'S MESSAGE

I intently believe that you should have an all-round development of your personality, having ambitions and aims untrammeled and hard work, enthusiasm, resilience laced with knowledge and intellect which will take you to any extent you desire. Make it a habit to read newspapers daily and ensure the optimum use of library. In today's world, professional approach towards things is necessary. Understanding the basics, relating them to real world situations and then building them into bigger things will help you to become a better engineer. Time management is another asset in the fervent stride for success. Endeavour to be a better human being while foraying in the competitive life, realizing your dreams, honesty and integrity should be your second names. The college life provides the opportunity to develop one's personality to the fullest extent. The college magazine not only harnesses the skill of writing in the students but also inculcates the pleasure of reading among them.

- Dr. S. M. Khot

HOD'S MESSAGE

Mechanical Engineering is considered to be an evergreen branch and consists of Thermal, Design and Manufacturing as three different domains. It is one of the broadest engineering disciplines, offering students a wide range of career options and always remains at the center of all technical advancements. Due to the technological advancement in engineering field in general, the role of mechanical engineer is changing rapidly. To meet the ever-changing requirement of the industry and sustain in today's scenario, Mechanical Engineers must have knowledge and skills in multiple domains and multidisciplinary area to cater to the needs of allied industries. There is a need for Mechanical Engineering students to cultivate ideas that allow them to be absorbed in these emerging fields. In current situation mechanical engineers have wide scope in the field of Biomedical, Logistics, Automation, Renewable Energy, etc.

I am glad that Mechanical Engineering Students Association (MESA) is doing excellent work. Every year MESA organizes events such as Synergy, MESH, Industrial Visit, Poster Presentation, URJA (annual magazine) and CALIBRE (National Level Project Competition). These events help students to get acquainted with latest trends in industries and research. I would like to congratulate the magazine committee for their efforts.

- **Dr. Nilaj N. Deshmukh**

CORDINATOR'S MESSAGE

MESA is a collegiate organization which stands for Mechanical Engineering Students Association. The objective of MESA is to create opportunities for students to enhance their knowledge about the latest developments in the technological world, by organizing various events. The MESA council of F.C.R.I.T., Vashi has ensured a continuous flow of ideas and knowledge by conducting seminars every year. These seminars give the students a sneak peak in the outside world. SYNERGY and MESH are the two events conducted every year under the aegis of MESA. In SYNERGY, one industry is identified during the year and is invited to the campus for interaction. The aim is to bridge the gap between industry and institute and provide an opportunity for staff and students to directly interact with them. During MESH, a seminar lecture series is organized in which expert speakers from industry and academia such as BARC, IIT etc. are invited to deliver lecture in their area of expertise. A project poster presentation is also organized wherein the final year students display their projects and present posters of their respective projects. Students display their projects and present posters of their respective projects. Students of lower semesters get an opportunity to have a glimpse of the type of project being carried by final year students. Apart from these activities, MESA also publishes an annual magazine on various technological topics. The published articles are related to researches and inventions that many are unaware of and might be interested in.
MESA continuously works for the overall development of the personality of the student other than their academic responsibilities. MESA provides wings and sky to the mind which are planning to fly high and believe in wellness in work.

- **MESA Coordinator**

TABLE OF CONTENTS

ABOUT MESA

MECHANICAL ENGINEERING STUDENTS' ASSOCIATION popularly called as MESA is a collegiate organization which relates the activities under Mechanical Engineering Department. MESA is among the most active student bodies in the institute. Mentored by experienced faculty members of the Mechanical Engineering department, students take upon many initiatives that prepare them to face the challenges of the future. MESA aims to create opportunities for the students to enhance their knowledge about the latest developments in the technological world by organizing various events. **SYNERGY** and **MESH** are the two events conducted every year as a part of activities under MESA. **SYNERGY** is conducted in the odd semester every year and **MESH** is conducted in the even semester during the college fest. Both these events provide a broader vision to the students regarding various technologies and developments happening in the professional field outside the college classrooms. In March 2018 MESA also conducted a technical fest named **CALIBRE** for the first time in department.

Functions of MESA:

- Promoting the interests of students in various technical areas pertaining to mechanical engineering.
- To promote interaction between academia and industry by organising industrial visits, special lectures and intellectual talks.
- Interacting with other technical societies, within and outside the institute to promote flow of knowledge and interest.
- To allow students to learn and focus on the cutting-edge technology by presenting it to the students in interesting manner through seminars and workshops.

MESA COUNCIL 2017-18

MESA CO-ORDINATORS: PROF. SUVARNA RODE
PROF. DEEPAK DEVASAGYAM

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SIMULTANEOUS LOCALISATION AND MAPPING

Harshit Singh (Mech V)

I. INTRODUCTION

Simultaneous Localization and Mapping or SLAM in short, is a problem which is trying to map the environment while simultaneously localizing (i.e. orienting itself) with respect to the surroundings with the help of different sensors and algorithms.

It is essentially building a map of an unknown environment while keeping track of your position. The basic SLAM framework involves odometry, landmark prediction, landmark extraction, data association and matching, pose estimation, and map update. These processes are the backbone of every major method, and are performed in a cyclic fashion.

While this initially appears to be a chicken-and-egg problem there are several algorithms known for solving it, at least approximately, in tractable time for certain environments.

II. HISTORY

Research on SLAM began arguably with the papers of R.C. Smith and P. Cheeseman in 1986, usually with wheeled robots traversing a flat ground plane. Typically, this has been done by combining sensor readings (such as from a laser scanner or sonar) with information about the control input (e.g. steering angle) and the measured robot state (e.g. counting wheel rotations).

This may seem far removed from tracking a handheld camera freely moving in space, but embodies many of the core difficulties of SLAM, such as creating a consistent and accurate map, and making best use of multiple unreliable sources of information.

III. BASIC PROCESS

SLAM is similar to a person trying to find his or her way around an unknown place. First, the person looks around to find familiar markers or signs. Once the person recognizes a familiar landmark, he or she can figure out where they are in relation to it. If the person does not recognize landmarks, he or she will be labeled as lost. However, the more that person observes the environment, the more landmarks the person will recognize and begin to build a mental image, or map, of that place. The person may have to navigate this certain environment several times before becoming familiar with a previously unknown place.

In a related way, a SLAM robot tries to map an unknown environment where it is at where it is at. The complexity comes from doing both these things at once. The robot needs to know its position before answering the question of what the environment looks like. The robot also has to figure out where it is at without the benefit of already having a map. Simultaneous localization and mapping, developed by Hugh Durrant-Whyte and John L. Leonard, is a way of solving this problem using specialized equipment and techniques.

The process of solving the problem begins with the robot or unmanned vehicle itself. The type of robot used must have an exceptional odometry performance. Odometry is the measure of how well the robot can estimate its own position. This is normally calculated by the robot using the position of its wheels. Something to keep in mind, however, is that there is normally a small margin of error with odometry readings. The robot might be off in its measurements by several centimeters.

Consequently, the robot is not where it thinks it is in a given location. These errors must be considered in algorithms. Also, areas are often remapped to make up for this deficiency.

IV. SENSORS USED

One of the criteria for an autonomous robot is the ability to

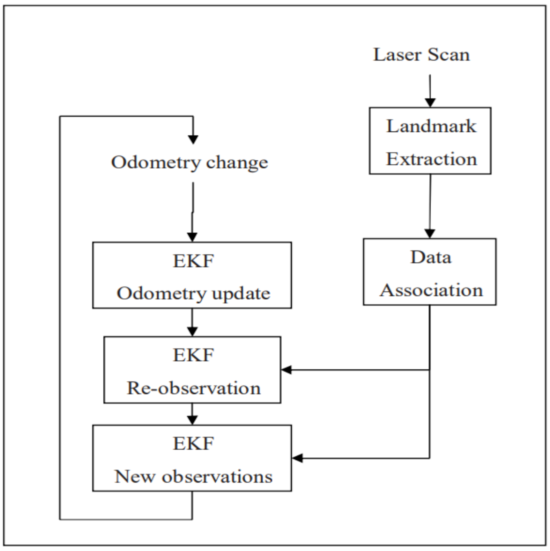

Fig.1.1. Overview of the SLAM process using a Laser.

sense its environment. The robot's sensors transduce environmental conditions into signals suitable for processing by the robot. Proper sensor selection is crucial as it affects the quality and quantity of environmental information available to the robot and subsequently determines what SLAM approach is most suitable to be used.

A. Acoustic Sensors

Sonar sensors are mostly used underwater where laser and visual sensors struggle. Lower frequency sonar minimizes absorption, and sonar provides much better resolution in a subsea environment. Ultrasonic sensors are generally the cheapest available source of spatial sensing for mobile robots. They are compatible with most surface types, whether metal or non-metal, clean or opaque, as long as the surface measured has sufficient acoustic reflectivity. However, low spatial resolution and sensing range as well as sensitivity to environmental factors and slow response speeds hamper robotic use of ultrasonic sensors

B. Laser Range Finders

Laser-based systems are one of the most popular choices for solving the SLAM problem. Laser-based systems are able to obtain robust results in both indoor and outdoor environments. The high speed and high accuracy of laser range finders enable them to generate highly precise distance measurements.

C. Stereo Vision Sensors

Vision sensors can be used to estimate 3D structure (allowing for spatial information extraction), feature location, and robot pose using monocular or stereo cameras compare monocular and stereo vision systems in SLAM. Stereo cameras gain sparse distance information from disparity in textured areas of the image. Monocular cameras, on the other hand, obtain depth information of an object by repeatedly observing features to get the feature's parallax. It is worth noting that similar techniques can be applied to stereo vision cameras as well.

D. RGB-D Sensors

RGB-D depth sensors project structured infrared spectrum light which is then perceived by a small baseline infrared camera. Structured light sensors are sensitive to external illumination; hence they are not usable under direct sunlight. Recent advances in computer vision, computer science, information technology, and engineering have enabled manufacturers to deliver real-time information and guidance at the point of use. Users simply follow the text, graphics, audio, and other virtual enhancements superimposed onto goggles ordeal assemblies as they perform complex tasks on the factory floor. These tools can simultaneously assess the accuracy and timing of these tasks, and notify the operator of quality risks.

V. Applications

Today SLAM is employed in self-driving cars, unmanned aerial vehicles, autonomous underwater vehicles, planetary rovers, newer domestic robots and even inside the human body.

The self-driving STANLEY and JUNIOR cars, led by Sebastian Thrun, won the DARPA Grand Challenge and came second in the DARPA Urban Challenge in the 2000s, and included SLAM systems, bringing SLAM to worldwide attention. Mass-market SLAM implementations can now be found in consumer robot vacuum cleaners. Self-driving cars by Google and others have now received licenses to drive on public roads in some US states.

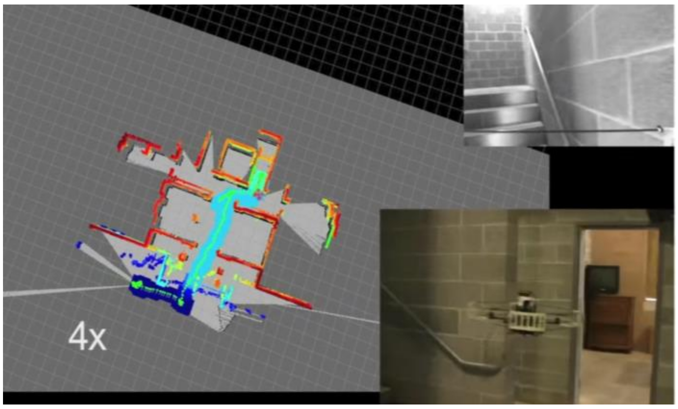

Fig. 1.2. A Drone using SLAM algorithms to navigate through a building.

VI. CONCLUSION

In today's world solving SLAM is an essential task for the autonomy of a robot and it is an active field of research within computer vision and new and improved techniques are constantly emerging.

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OVERESTIMATING AUTOMATION AND UNDERESTIMATING HUMANS

Priyan Kamble (Mech V), Shraddha Barbade (Mech V), Aishwarya Harad (Mech V)

I. INTRODUCTION

Automation is the technology by which a process or procedure is performed without human assistance. Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat-treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention. Some processes have been completely automated

Automation covers applications ranging from a household thermostat controlling a boiler, to a large industrial control system with tens of thousands of input measurements and output control signals. In control complexity it can range from simple on-off control to multi-variable high-level algorithms.

Fig 2.1. Automation with Robotic Arm in Tesla Inc.

II. TESLA'S OVER-AUTOMATION

Tesla has been hoping to produce 5,000 new Model 3 electric cars each week in 2018. So far, it has failed to manufacture even half that number. Questioned on the matter, the company's CEO, Elon Musk, claimed that "excessive automation has been a mistake" and that "humans are underrated".

He's not wrong – the recent drive for full automation has overlooked the importance of adaptability. Humans are still far more able to adapt to change than artificial intelligence (AI). In the long-term, AI has the potential to replace human workers, but for now leaders need to determine the right speed of change.

The Tesla factory in Silicon Valley is highly automated. Early on, Musk understood that any process following a sequence of predefined steps and taking place on a fairly controlled environment, such as a factory floor.

But while autonomous systems are developing rapidly, humans remain far better at adapting to unforeseen changes. When it comes to complex factory work, this is something that should not be underestimated. Looking back on Tesla's productivity issues, Musk undoubtedly missed the importance of adaptability in manufacturing. The probability of small errors and unforeseen situations is proportional to the complexity of the process, especially when the process takes place in the physical world workers, which should include employees who can design and build IoT products as well as data scientists who can analyze output.

III. ADAPTIVE INTELLIGENCE

Humans and other forms of intelligent life evolved to survive in a constantly changing world. For this reason, they can cope remarkably well with unforeseen situations and discrepancies between expected and actual events. As cognitive scientist Gary Marcus emphasises, there are a lot of things "that go into human intelligence, like our ability to attend to the right things at the same time, to reason about them to build models of what's going on in order to anticipate what might happen next and so forth."

Humans and animals can also adapt their bodies to radically different situations in order to achieve their goals. For example, we can move forward by walking, swimming, jumping, climbing and crawling – and we can do so even if we lose the use of a limb. These dynamic aspects of biological systems help them cope with radical change under highly complex situations.

Machine learning, on the other hand, is not yet at the level of human intelligence and adaptability. Sure, we have made great progress. Today, advanced AI algorithms, inspired by nervous systems, can learn to recognise similar situations like a traffic light turning red or a ball falling on the street even better than humans. Developments in robotics also mean that new robots made of soft materials can physically adapt to unforeseen objects in the physical environment. But in both cases, adaptability is limited to variations within a restricted category of objects or events.

The truth is that we have not yet mastered the design of robots and AI that are resilient enough to respond to unpredictable environments. Take the example of robots used in the packaging industry. Automated guided vehicles with limited on-board intelligence can only follow simple programming instructions taking them along fixed routes in a defined environment. These robots might be able to pick up a product and place it into a carton, without the ability to do anything more complex. When the job changes, the robot will have to be replaced.

More complex mobile robots are also in use. They have built-in sensors and scanners, as well as software that allows them to detect their surroundings and choose the most efficient route so that a product is not necessarily placed in the same location every time. These more complex robots are more flexible and adaptable, but they are still quite far away from what biological systems can do.

This could be a problem for overly automated factories where small physical discrepancies (a broken wheel, wear and tear on the ground, imprecisely positioned parts) can rapidly accumulate and result in unpredictable situations (a component is not where it should be, a robot is missing). When a process changes or the factory starts making a new product, then there is a need to reconfigure the equipment and find a different solution. This is not yet entirely within reach of AI and robotics

IV. FULL AUTOMATION

Musk has publicly noted his desire to create a fully autonomous factory. His underlying goal is to overcome the limits of human speed. With greater speed, higher outputs can be achieved. But in complex environments, such as a highly automated factory, there is a need for highly adaptable robots that can respond to unforeseen situations and to each other like biological systems do. Introducing that sort of biological resilience in robotics and AI requires further research.

The first involves testing robotic automation within a defined set of processes, such as picking raw material and placing it on the assembly line. The second involves expanding that test to multiple functions and processes, such as combining the raw material and packaging the product. The third stage is to deploy robotic co-workers and adaptive AI as human assistants. Today, this is the best we can aim for.

It is not yet clear when we will have the technology for full automation without human intervention (stage four) and what form it will take but Musk should be praised for trying. He may have underestimated humans but what he is learning is precious and will help him to drive ahead of others in the future.

V. SHADOW OF AUTOMATION

"On going reductions of headcount in outsourced businesses (due to automation) will eventually result in a scenario where (only) 30 per cent of the workforce will remain relevant," said DD Mishra, Research Director at Gartner.

This, he believes has largely to do with the fact that as automation adoption increases, 70 per cent of the workload can be handled by machines, without the need for humans to intervene.

"It is bound to accelerate faster in the next year as companies look to enhance performance and garner insights from run-of-the-mill tasks," according to Ashutosh Sharma, VP and Research Director, Forrester India.

Fig 2.2. Automation in Assembly Line in Production Industry

VI. CONCLUSION

As the birth rate in many countries declines, the share of the working age population will shrink. To maintain today's GDP, those workers will each need to be more productive than workers today, and they'll need to improve at a faster rate than they have in the past. Even if productivity continued to improve at the same rate that it has throughout the last 50 years—within which the computer and the internet both became mainstream tools—it wouldn't be enough of an improvement to sustain GDP. Automation technology could be the answer. According to a McKinsey analysis, it could raise global productivity by as much as 0.8% to 1.4% annually—but only if humans keep working, as well.

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THE KEY TECHNOLOGY TOWARDS THE SELF-DRIVING CAR

Joe Nishit (Mech V)

I. INTRODUCTION

The self-driving car, also termed as the wheeled mobile robot, is a kind of intelligent car, which arrives at a destination based on the information obtained from automotive sensors, including the perception of the path environment, information of the route and car control. The main characteristic of a self-driving car is transporting people or objects to a predetermined target without humans driving the car. According to the National Highway Traffic Safety Administration, the self-driving car can be classified into four levels, as described in figure 1. Due to the maturity of Levels 1 and 2, this article discusses Level 3 and 4.

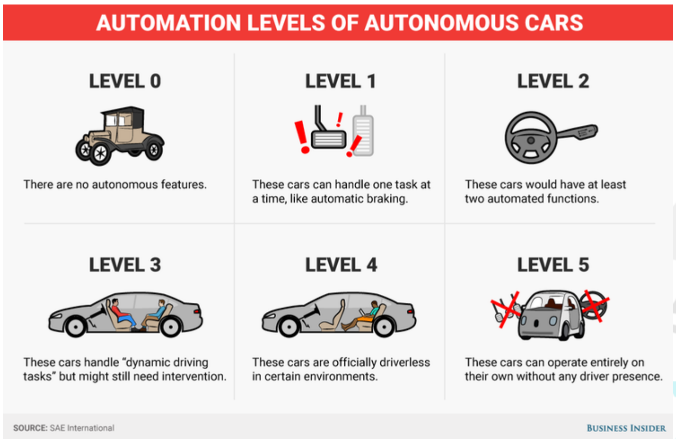

Fig. 3.1. Automation levels of autonomous cars

II. THE KEY TECHNOLOGY

The automatic control, architecture, artificial intelligence, computer vision and many other technologies are integrated into the self-driving car, which is a product of the highly developed computer science, pattern recognition and intelligent control technology. From a different viewpoint, the technology of self-driving car represents the level of scientific research and industrial strength of a country. Compared with manual driving, it is a key characteristic of a self-driving car that using automation equipment to replace the human driver. Based on this characteristic and functional requirement on driving anon-board equipment module, the core technology of self-driving car is classified into four key parts, which are known as car navigation system, path planning, environment perception and car control.

III. CAR NAVIGATION SYSTEM

During self-driving, two issues, which are the current location of the car and how to go from the location to the destination, must be resolved. Certainly, the above two issues can be solved by a human's own knowledge.

However, in self-driving, the car must be able to automatically and intelligently locate its position and perform the path planning to destination. For this objective, the on-board car navigation system is deployed on the self-driving car. The structure of car navigation system and its metadata processing model are depicted in figure 2.

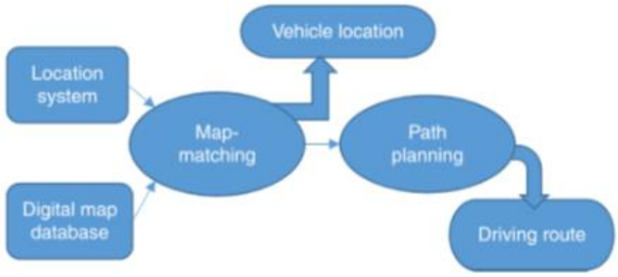

Fig. 3.2. Car Navigation Diagram

In the car navigation system, geographic information system and global positioning system (GPS) are equipped to receive the location information such as longitude and latitude from the satellite. This information, together with the road information generated by location system and digital map database, serve as the source data inputted into the map-matching model, where the intelligent path planning algorithms (i.e. Dijkstra algorithm, Bellman-Ford algorithm) are utilized to enable the path planning calculation. After calculation, the self-driving car can locate itself. With the information of the self-driving car's location and the destination, the driving route can also be programmed and calculated by the path planning model.

IV. LOCATION SYSTEM

The main purpose of the location system is to determine the vehicle location, which generally can be classified into relative location, absolute location and hybrid location. For relative location, the current position of self-driving car is obtained by adding the moving distance and direction to the prior position. For instance, inertial navigation system (INS) (Farrell and Barth, 1999) is a common relative location system. In INS, the vehicle angular velocity and accelerated velocity are obtained by the gyroscope sensor and accelerometer installed in the car. By integrating these data (i.e. angular velocity, accelerated velocity), the car's relative course angle and speed can be calculated. Similarly, the car's direction and mileage can be obtained by integrating the course angle and speed once again. Combining with the prior vehicle location, the current vehicle location can be calculated. However, due to the vehicle vibration during moving, it is inevitable to lead to the deviation between the calculated location and actual location. The absolute location method is used to locate the vehicle's position according to the information obtained from positioning system. A common positioning system is the satellite-based system, such as GPS, GLONASS, Galileo, Beidou and so on. However, the satellite signal is prone to the interference from the weather conditions and urban environment, such as building and mountain, which will cause error and noise in the location signal, and thus the measured absolute location is not accurate. The hybrid location, which combines the characteristics of the above two locating methods, is the most common method used in obtaining the position of a self-driving car.

V. ELECTRONIC MAP (EM)

EM is used for digital map information storage, which mainly includes geographical characteristics, traffic information, building information, traffic signs, road facilities, etc. Nowadays, most of the EMs which are used in a self-driving car are the EMs designed for humans. Now, the EM for self-driving car named HD map has already shown up. Compared with the traditional map, on the one hand, the accuracy of absolute coordinates of an HD map is higher. For example, it is declared that its next generation of drawing applications will be accurate in centimeters and, on the other hand, the road traffic information elements are richer and more detailed. In particular, the HD map is divided into three layers: the active layer, the dynamic layer and the analytical layer:

(1) Active layer, compared to the traditional map, adds HD road-level data (road shape, slope, curvature, laying, direction, etc.), the data of lane attribute (lane type, lane width, etc.) and the elevated objects, guardrail, trees, road edge types, roadside landmarks and other large target data.
(2) Dynamic layer will update real-time traffic data from other vehicle sensors and road sensors. The update and supplement are in real time. This is the second phase of HD map, namely, network integration-collaborative perception.
(3) Analysis layer helps train self-driving car by analyzing the real-time big data of human driving records. Therefore, the HD map enters the third phase of network integration-coordinated decision-making and control.

VI. MAP MATCHING

Map matching, which is the foundation of the path planning, calculates out the car's location by using the geographical information from GPS/INS and the map information from EM. During the calculation, the advanced fusing technique is employed to fuse the longitude and attitude or another coordinates information into the EM. From the practical viewpoint, the output of car location should be accurate and time efficient. In this regard, it is an important issue to find a good method to fuse the information from GPS and INS. In fact, sometimes the satellite signal in GPS or the INS could be lost, therefore, a good data fusion method that can integrate the information from the existing location and route scenario will greatly enhance the accuracy, robustness and reliability.

VII. GLOBAL PATH PLANNING

Global Path Planning is used to calculate the optimal driving path between the start point and end point. Generally, the typical path planning algorithms, such as Dijkstra algorithm, Bellman-Ford algorithm, Floyd algorithm and heuristic algorithm are employed to fuse the EM information and calculate the optimal path. Due to the global path, planning is at mature stage and already implemented commercially on a large scale.

VIII. RADAR PERCEPTION

Radar perception is generally used for distance detection, which is achieved by calculating the return time of millimeter wave transmitted by the radar sensor. The major global suppliers of automotive millimeter wave radar are traditional enterprises with advantage of automotive electronic, such as Bosch, Continental, Hella, Fujitsu Ten, DENSO, TRW, Delphi, Autoliv and Valeo and so on. Among them, the core product of Bosch is a long-range millimeter wave radar, which is mainly used in the ACC system. The latest product LRR4 can detect vehicles 250 meters away, as currently it is the only wave radar with farthest detection range of millimeter and has the highest market share.

IX. VISUAL PERCEPTION

Visual perception is necessary for a self-driving car, i.e. it is necessary to identify the traffic signals. Most traffic signals are designed for the human vision; therefore, it is necessary to recognize the traffic signal. Besides, the machine vision is also used for location, navigation, to judge the motion and so on. The primary one is Simultaneous Localization and Mapping (SLAM) based on the map.

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DLR LIGHTWEIGHT ROBOT

Vipin Varughese (Mech V)

I. INTRODUCTION

The DLR lightweight robots have been developed for application areas which are fundamentally different from those of classical industrial robotics. The strengths of industrial robots are especially high positioning accuracy (repeatability and absolute accuracy), high speed, durability, and robustness, as well as the relatively low price. Therefore, today's industrial robots are used in well-structured environments, in which the position and shape of the parts to be manipulated are well determined and in which collisions with the environment and humans can be estimated and are excluded in advance. High performance is achieved for fast tasks which are repeated numerous times. Generally, the high positioning accuracy requires high stiffness at the price of high robot mass relative to its payload. In contrast, the robotic systems developed at DLR (arms, hands, a humanoid manipulator) are designed for interaction with humans in unstructured, everyday environments. In such applications, high absolute positioning accuracy cannot be exploited due to limited accuracy of position information about the surrounding environment, while its side-effects in design (high stiffness and mass) are clearly undesired.

These are some of the typical examples of application areas where the DLR robots are designed to function which are generally not covered by the industrial robots.

• Assembly processes for which the position estimation for the mating parts and/or the positioning accuracy of the robot is significantly below the assembly tolerance.
• Applications in which the robot works in immediate vicinity of humans and possibly in direct physical cooperation with them.
• Mobile service robotics applications (arms mounted on mobile platforms), for which the information about the position of the robot and the surrounding objects, as well as about the dimension of these objects is afflicted with relatively high uncertainty.

II. HARDWARE OVERVIEW

The main design goals of DLR lightweight robots is to build a manipulator with kinematic redundancy similar to human arm i.e. 7 DOF, load to weight ratio of approx. 1:1, total system weight of less than 15kg for arms with a work space of up to 1.5m, high dynamic performance. No bulky wiring and electronics cabinet as in industrial robots. The full state measurement in all joints is performed in a 3kHz cycle, using

- strain gauge-based torque-sensing
- motor position sensing based on magneto-resistive encoders, and
- link-side position sensing based on potentiometers (used only as redundant sensors for safety considerations).

High performance is obtained by lightweight harmonic drive gears and robo-drive motors possessing high energy density.

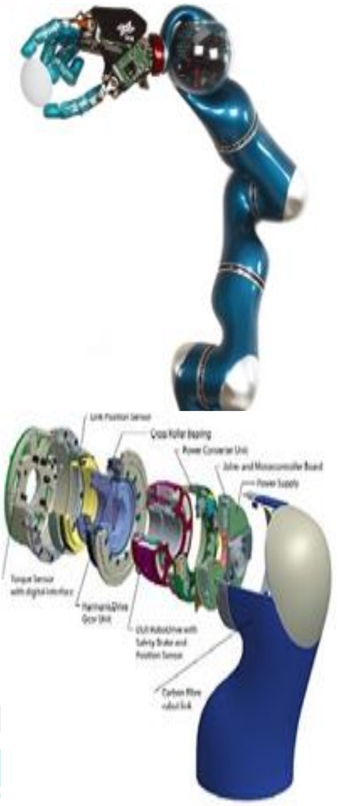

Fig. 4.1. Robotic Arm

III. CONTROL ASPECTS FOR ROBOTS ACTING IN HUMAN ENVIRONMENT

Torque sensing and feedback becomes essential, both for increasing motion accuracy of the flexible arm, as well as for direct monitoring and control of the interaction forces. Measuring the torques in the joints is important, since the robot is always likely to collide or deliberately be in contact with its surrounding environment.

A. Joint Level Control:

At joint level, a decentralized state feedback controller is implemented by using the entire joint state in the feedback loop, namely the motor position and velocity, the joint torque and its derivative. An alternative to the joint torque is to use the link side position and velocity for control. With the feedback gains, the controller structure is used to implement position, torque or impedance control. The feedback terms turn out to have very intuitive physical interpretations: torque feedback reduces the apparent inertia of the motors, as well as the joint friction. Motor position feedback is equivalent to a physical spring while velocity feedback produces energy dissipation (viscous friction).

B. Cartesian Impedance Control:

During applications in which the robot is mainly in contact with the environment, it is useful to control the forces rather than the positions in some Cartesian directions. A smooth transition between both operation types is realized by impedance control, where, rather than controlling generalized force or position, the relation between them is specified (e.g. as a stiffness and damping) together with a nominal desired position. With the physical interpretation of torque and position feedback, it is intuitive to design a Cartesian compliance by utilizing the joint level torque controller for reduction of motor inertia and friction and by replacing the joint level stiffness with a Cartesian spatial spring.

C. Inverse Kinematics:

An algorithm has been developed which allows the introduction of constraints at the kinematics level. With this constraint optimization approach, singularity handling is realized, in order to enable the crossing of singularities along a specified path. For singularity crossing, two different strategies are known: deviation from the desired trajectory and deceleration from the desired trajectory. Within the implemented algorithm, both strategies are unified; deviation in specified directions and deceleration can be combined and arbitrarily mixed within the optimization problem.

IV. JUSTIN: A "SOFT" HUMANOID WITH LIGHTWEIGHT TECHNOLOGY

Based on the DLR lightweight robots a humanoid upper-body-system Justin has been set up as a testbed for studying two-handed manipulation. This system consists of two four-fingered DLR- hands-II and two 7DOF lightweight robots mounted on a 3 DOF movable torso. Utilizing the modular structure of the arms and hands, the system has been assembled symmetrically in a humanoid configuration with a right-handed and a left-handed sub-system. Furthermore, the technologies developed for the DLR arms have also been utilized in the design of the torso. Consequently, all 41 DOF of the torso, the arms, and the hands have joint torque sensors in addition to the common motor position sensors. This facilitates the implementation of coordinated control algorithms for Justin, since the same control concepts can be used for all the joints. For two-handed manipulation tasks we use passivity-based controllers which are derived from the Cartesian impedance control concepts developed for the arms.

Inner loop joint torque controllers are used for all joints in order to overcome the negative effects of high motor inertia and friction due to the gears. Based on the position of the fingertips a virtual frame is defined for each hand. The fingertips are connected via virtual (one-dimensional) interconnection springs to these virtual frames. By changing the rest lengths of the interconnection springs one can control the grasping forces of the right and the left hand. The applications for which this type of impedance has been used up to now include the coordinated transport of an object by two arms and hands, and the opening of a can by unscrewing the cap.

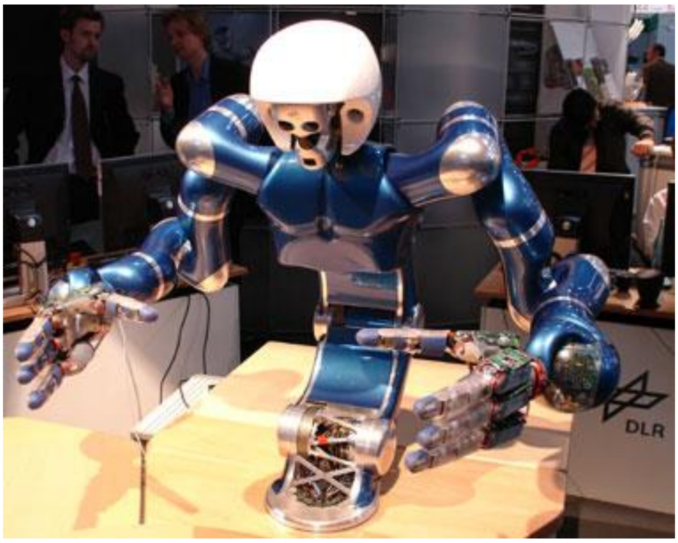

Fig. 4.2. Justin the soft humanoid

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AN INTELLIGENT REGENERATIVE BRAKING STRATEGY

Johnal D’Souza (MECH V)

I. INTRODUCTION

The invention of electric vehicle (EV) is a miracle, it is also known as green vehicle as it produces zero emission in the air which means there are no toxic gasses released from the car that causes the ozone layer polluted. Nowadays, the population of EV starts increasing according to the demand in the market. Besides, the enforcement by the government toward the production of electric car is getting more serious. Every step is taken intensively by the world to save the Mother Nature from the excessive air pollution and the recession on the natural resources such as crude oils and natural gasses in the earth.

Fig. 5.1. Regenerative Braking System

In twentieth century, vehicular technology such as control technology and integrative technology have been developing aggressively. Somehow, the limitation of driving mileage still becomes an obstacle for the development of electric vehicles. This problem had been tackled by using regenerative braking, it has become one of the ways to improve the driving range as this method can increase an EV's driving range by 8-25% and fuel efficiency of a HEV by 20-50% depending on the motor size.

This technology had mostly replaced the traditional braking system in the cars because the traditional braking system always utilizes mechanical friction method to dissipate kinetic energy as heat energy in order to achieve the effect of stopping. Studies show that in urban driving, about one third to one half of the energy required for operation of a vehicle is consumed during braking. Based on the energy perspective, the kinetic energy is a surplus energy when the electric motor is in the braking state since it dissipated the energy as heat and causes a loss of the overall energy. This wasted energy actually can be converted to a useful energy especially for the hybrid and electric car.

Therefore, regenerative braking had been implemented in the car braking system to recapture this wasted energy. In addition, the total energy saves are dependent on the driving condition, normally it is more effective in city driving rather than highway whereas little braking occurs. There are several advantages of regenerative braking taken over the traditional braking system such as:

- More control over braking
- More efficient and effective in stop-and-go driving conditions
- Prevents wear on mechanical brake systems
- Better fuel economy

II. REGENERATIVE BRAKING SYSTEM

A. Working Principle

Regenerative braking is a braking method that utilizes the mechanical energy from the motor by converting kinetic energy into electrical energy and fed back into the battery source. Theoretically, the regenerative braking system can convert a good fraction of its kinetic energy to charge up the battery, using the same principle as an alternator.

In regenerative braking mode, it uses the motor to slow down the car when the driver applies force to the brake pedal then the electric motor works in reverse direction thus slowing the car. While running backwards, the motor acts as the generator and recharge the batteries. Meanwhile the car in normal running condition whereas the motor turning forward and taken energy from the battery.

By using regenerative braking, it vastly reduces the reliance on fuel, boosting fuel economy and lowering emissions. These types of brakes work effectively in driving environment such as stop-and-go driving situations especially in urban city. The regenerative braking system provides the majority of the total braking force during low speed and stop-and-go traffic where most of deceleration is required.

B. Regenerative Braking Controllers

In the regenerative braking system, the braking controller is the heart of the system because it controls the overall process of the motor. The functions of the brake controller are monitor the speed of the wheel, calculate the torque, rotational force and generated electricity to be fed back into the batteries. During the braking operation, the brake controller directs the electricity produced by the motor into the batteries or capacitors.

Regenerative braking is implemented in conjunction with anti-lock braking systems (ABS), so the regenerative braking controller is similar to an ABS controller, which monitors the rotational speed of the wheels and the difference in that speed from one wheel to another. If it isn't, the brake controller turns the job over to the friction brakes, averting possible catastrophe. In vehicles that use these types of brakes, as much as any other piece of electronics on board a hybrid or electric car, the brake controller makes the entire regenerative braking process possible.

C. Hybrid Regenerative Braking

If a hybrid is to have maximum fuel efficiency and produce as few carbon emissions as possible, it's important that the battery remain charged as long as possible. If a hybrid vehicle battery is to lose its charge, the internal combustion engine would be entirely responsible for powering the vehicle. At that point, the vehicle is no longer acting as a hybrid but rather just another car burning fossil fuels. In a hybrid setup, however, these types of brakes can provide power only to the electric motor part of the drivetrain via the vehicle's battery. The internal combustion engine gains no advantage from these kinds of brakes. In part, these efficiencies are necessary due to the extreme difficulty in finding a place to recharge a hybrid. This makes longer trips difficult without relying on the hybrid's internal combustion engine, thus regenerative brakes play a crucial rule.

D. Hydraulic Regenerative Braking

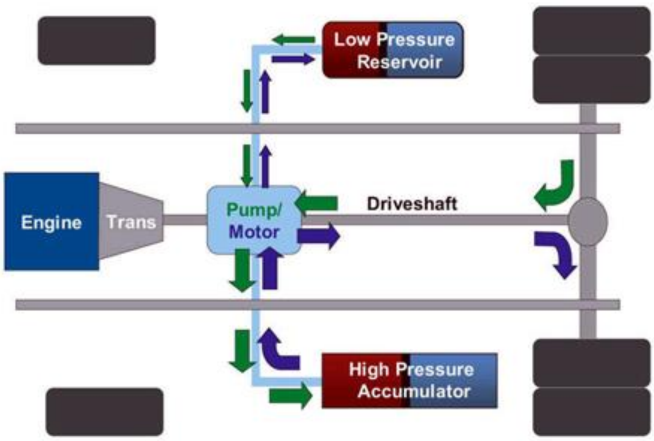

Fig. 5.2. Hydraulic Regenerative Braking

An alternative regenerative braking system is being developed by the Ford Motor Company and the Eaton Corporation. It's called Hydraulic Power Assist or HPA. With HPA, when the driver steps on the brake, the vehicle's kinetic energy is used to power a reversible pump, which sends hydraulic fluid from a low-pressure accumulator (a kind of storage tank) inside the vehicle into a high-pressure accumulator. The pressure is created by nitrogen gas in the accumulator, which is compressed as the fluid is pumped into the space the gas formerly occupied. This slows the vehicle and helps bring it to a stop. The fluid remains under pressure in the accumulator until the driver pushes the accelerator again, at which point the pump is reversed and the pressurized fluid is used to accelerate the vehicle, effectively translating the kinetic energy that the car had before breaking into the mechanical energy that helps get the vehicle back up to speed. This percentage represents an even more impressive gain than what is produced by current regenerative braking systems. Like electronic regenerative braking, these kinds of brakes -- HPA systems are best used for city driving, where stop-and-go traffic is common.

E. Regenerative Braking Efficiency

The energy efficiency of a conventional car is only about 20 percent, with the remaining 80 percent of its energy being converted to heat through friction. The miraculous thing about regenerative braking is that it may be able to capture as much as half of that has beented energy and put it back to work. This could reduce fuel consumption by 10 to 25 percent. Hydraulic regenerative braking systems could provide even more impressive gains, potentially reducing fuel use by 25 to 45 percent. The added efficiency of regenerative braking also means less pain at the pump, since hybrids with electric motors and regenerative brakes can travel considerably farther on a gallon of gas, some achieving more than 50 miles per gallon at this point. And that's something that most drivers can really appreciate.

III. CONCLUSION

These kinds of brakes allow batteries to be used for longer periods of time without the need to be plugged into an external charger. These types of brakes also extend the driving range of fully electric vehicles. In fact, this technology has already helped bring us cars like the Tesla Roadster, which runs entirely on battery power. Sure, these cars may use fossil fuels at the recharging stage -- that is, if the source of the electricity comes from a fossil fuel such as coal -- but when they're out there on the road, they can operate with no use of fossil fuels at all, and that's a big step forward. In conclusion, the regenerative braking is a tremendous concept that has been developed by the automotive engineers. In the near future, if this system is fully utilized and further improve, a new generation of electric vehicle will be fully on the road.

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SMART CITIES – USING SOLID STATE LIDAR SENSOR FOR TRAFFIC MANAGEMENT

Poorva Khare (MECH VII)

I. ABSTRACT

Modern society faces serious problems with transportation systems, including but not limited to traffic congestion, safety, and pollution. Information communication technologies have gained increasing attention and importance in modern transportation systems. Automotive manufacturers are developing in-vehicle sensors and their applications in different areas including safety, traffic management, and infotainment. Government institutions are implementing roadside infrastructures such as cameras and sensors to collect data about environmental and traffic conditions. By seamlessly integrating vehicles and sensing devices, their sensing and communication capabilities can be leveraged to achieve smart and intelligent transportation systems. We discuss how sensor technology can be integrated with the transportation infrastructure to achieve a sustainable Intelligent Transportation System (ITS) and how safety, traffic control and infotainment applications can benefit from multiple sensors deployed in different elements of an ITS.

II. INTRODUCTION

Transportation systems have become a fundamental base for the economic growth of all nations. Nevertheless, many cities around the world are facing an uncontrolled growth in traffic volume, causing serious problems such as delays, traffic jams, higher fuel prices, increase of CO2 emissions, accidents, emergencies, and the degradation of quality of life in modern society. According to a report by the Texas Transportation Institute, in the United States, commuters spend approximately 42 h a year stuck in traffic, drivers has beente more than 3 billion gallons of fuel per year, having a total nationwide price tag of $160 billion, equivalent to $960 per commuter [1]. Such problems will worsen in the future because of population growth and the increasing migration to urban areas in many countries around the world as reported by the United Nations Population Fund [2]. Hence, there is a strong need to improve the safety and efficiency of transportation.

In ITS, identifying the type of sensors to develop applications that contribute to address problems such as: (1) traffic congestion and parking difficulties, (2) longer commuting times, (3) higher levels of CO2 emissions, and (4) increase in the number of road accidents, among others is of critical importance for improving a vehicle's performance.

Proximity, ultrasonic and electromagnetic sensors are used in parking assistance and reverse warning applications. Proximity sensors can detect when a vehicle gets close to an object. Ultrasonic sensors use a type of sonar to identify how far the vehicle is from an object, alerting the driver when the vehicle gets closer than a set threshold.

III. RADAR AND LIDAR

Radio Detection and Ranging (RADAR) and laser sensors constantly scan the road for frontal, side and rear collisions and allow safety applications to adjust throttle and activate brakes to prevent potential collisions or risk situations by using radio waves to determine the distance between obstacles and the sensor. The application notifies the driver if something close to the vehicle is detected and automatically activates the brakes to avoid a collision. Radar and speed sensors are used in applications that warn the driver of potential danger if changing lanes or wandering out of the lane is detected. The driver is usually warned through vibration in the seat or steering wheel or acoustically using an alarm. Cameras are used to: (1) monitor the driver's body posture, head position and eye activity to detect abnormal conditions such as signs of fatigue or the vehicle behaving erratically (driving out of a straight line on the road or pedestrians crossing suddenly in front of the vehicle) and (2) execute night vision assistance applications to help drivers see farther down the road and detect objects such as animals, people or trees in the path that can cause a potential risky situation or an accident.

LIDAR (Light Detection and Ranging) has become in a key component for the evolution of autonomous vehicles. LIDAR enables a self-driving car (or any robot) to observe the world with a few special characteristics such as continuous 360-degree visibility and highly accurate depth information. LIDAR sensors continually fire off beams of laser light, and then measure how long it takes for the light to return to the sensor.

IV. SSL TECHNOLOGY

Until recently, LIDAR sensors are not even considered for use in intelligent transport systems (ITS); however, new solid state (SSL) LIDAR technologies offer many possibilities in optical detection and ranging, allowing high-volume, cost-effective deployments in ITS applications.

SSLs can be used as stand-alone units or they can be combined with radars, cameras, induction loops, and other types of sensors to provide complementary information and/or redundancy. SSLs offer narrow and wide fields of view as well as independent detection segments. This means they can monitor specific areas such as bike paths or sidewalks, and survey a cities' one-lane streets and multi-lane boulevards, and highways.

SSLs can detect more than one target within the same detection segment, thanks to their advanced object discrimination capabilities. Their high measurement rates allow accurate vehicle tracking and measurements to be made, even at high speeds.

Measurement capabilities of SSLs for ITS applications

Detection	Detects the presence of one or more vehicles (as well as bicycles, pedestrians, etc.) in a given area.
Measurement	Locates objects in a zone to determine their distance from a sensor, and from each other. Can also measure vehicle height or length.
Profiling and classification	Enables vehicle classification through highly accurate cloud-point measurements, to sort objects out based on their dimensions and overall profile.
Tracking and speed	Rapid measurement rate allows tracking the displacement of an object in the sensor's field of view and determine/estimate its speed.

LIDAR delivers more benefits than radar, as it can provide higher resolutions and can detect live objects (pedestrians) and laterally-moving objects with a greater reliability. They also possess the ability of multi-object discrimination, and enable easier beam forming.

With a robust detection ability in all lighting conditions, better measurement capabilities, longer effective range, and better performance in inclement weather conditions, LIDARs also provide substantial benefits over camera vision solutions. As LIDAR is an active device that produces its own modulated signal, it therefore performs equally well in day and night conditions, and is immune to sunlight or vehicle lights.

V. INTERSECTION TRAFFIC LIGHT MANAGEMENT

Recent SSL-based traffic management systems offer advanced vehicle detection capabilities and accurate stop bar functionalities. As they are fixed above the ground, such as on existing traffic light posts, they can efficiently replace conventional induction loop sensors and simplify maintenance operations. Enhanced functionalities, such as traffic violation enforcement, are achieved when SSLs are combined with cameras and ALPR. SSL technology features excellent object discrimination and lateral positioning in its field of view. LIDAR sensors can compile hundreds of measurements per second in order to accurately locate vehicles of all sizes, including motorcycles and bicycles, as well as pedestrians.

Since sensors can measure several segments (in 2D configurations) or multiple pixels (in 3D configurations) with high sampling rates, data collected by SSLs can be employed to profile vehicles of all forms and shapes.

SSLs is a versatile sensing technology and enables e-toll applications, allowing conventional toll booths to be replaced by automated systems. The automated systems can be fixed on gantries above highways and streets. The LIDARs, as a part of such systems, can detect all of the incoming vehicles in all of the lanes. The triggered automatic license plate recognition (ALPR) provides the data needed for automated toll collection.

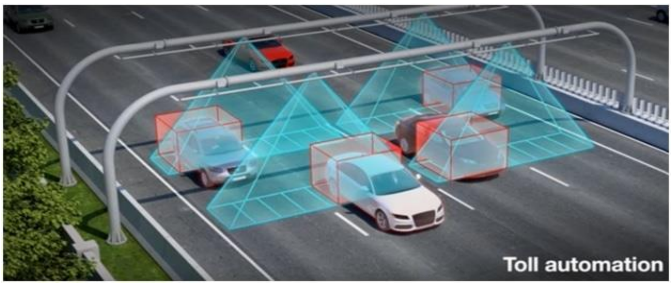

Fig 6.1. SSLs placed on gantries detect each passing vehicle and trigger ALPR system as part of an automated highway tolling system.

VI. CONCLUSION

Transportation and city authorities are now considering big data and real-time monitoring of road networks. Valuable information on vehicle speed, vehicle count, and type for a particular road can be provided by a wide-ranging network of SSL sensors. Such information can help optimize various aspects of infrastructure usage, overall commuting efficiency and traffic flows. As they do not have many positioning constraints, SSLs can be mounted directly on existing road infrastructure. An SSL captures only data, not images; this avoids privacy concerns, making LIDAR more socially acceptable than cameras.

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APPLICATIONS OF SUPRA MOTION

Joel Gregory (Mech V)

I. INTRODUCTION

Superconductors are materials with very special properties: if they are cooled below a certain temperature, their electrical resistance suddenly drops to zero. Below this so-called transition temperature, they can also freeze the field of a permanent magnet at a defined gap – meaning that either the magnet or they themselves start to hover.

The superconductor also resumes its saved position if it has been temporarily taken away or moved. The air gap remains steady in any spatial plane and enables objects to be moved to the other side of walls without contact. The principle can even be used in liquid and gas media, even in a vacuum.

II. APPLICATION OF SUPRA MOTION

A. SUPRADRIVE:

In the case of the Supra-Drive, a hovering slide is moved with high dynamics and is accurately positioned. Three cryostats with superconductors on both sides of the travel section allow it to hover a few millimeters above the surface. The drive from a Multi-Carrier-System which is fitted between the cryostats, takes care of the motion and positioning. Alongside the jerk-free acceleration and the almost wear-free dynamic motion, this concept has the advantage that all drive components can be installed under a cover. This makes it very easy to clean the system, even without interrupting the transport process. As the slide hovers, it cannot be hindered or contaminated by dirt on the surface of the system.

Easy cleaning whilst operating: The concept can be used in areas where facilities have to be frequently cleaned or cleaned during operation – for example in laboratory automation, medical technology, the food and pharmaceutical industries and packaging technology.

Fig. 7.1. Supra Carrier

B. SUPRA-CARRIER:

On a horizontally moving electrical axis, two superconductor elements are fitted, above each of which two magnetic transport rollers hover. A flat work-piece carrier lies on the rollers. Between rollers and the superconductors there is a cover with apertures. The rollers can be lowered through aperture so that the work-piece carrier is set down on the cover. The application is almost maintenance-free, very robust, works silently and the air gap has an insulating effect. The concept of magnetic hovering rollers is suitable for working with flat work-pieces and for transporting objects on a support plate. An application such as the Supra-Carrier could, for example, transport materials such as glass, wood or paper in very harsh – or extremely clean – environments.

Fig. 7.2. Supra Drive

C. SUPRA-HANDLING

With Supra-Handling, a superconductor slide hovers along two magnetic rails without contact and yet steadily. At the same time, the whole system can rotate about its longitudinal axis by up to 180 degrees. This means that the slide glides horizontally above the ground, vertically on the wall and can be suspended overhead. Plastic vials are also transported on the slide.

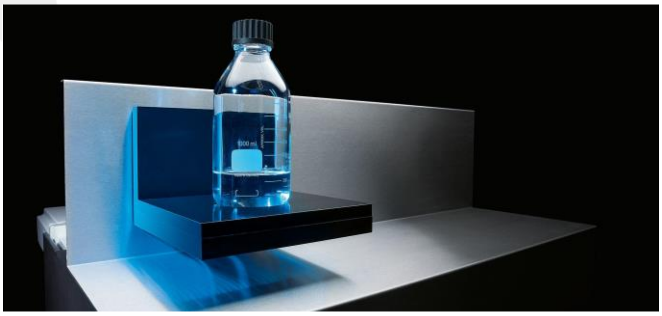

Fig.7.3. Supra Handling

Their mounting system is flexibly designed so that, even if their position is changed, they always remain vertical with the opening pointing upwards. Due to the smooth stainless-steel cover, the rails are easy to clean. The system can therefore be used at any place that requires a clean design and good clean-ability such as, in the food, chemical and pharmaceutical industries.

D. SUPRA LOOP:

Several carriers are transported on the Supra Loop. The magnetization on its underside is used both for coupling it with the contactless drive of a Multi-Carrier-System as well as for achieving the hovering effect with the Supra Motion system. A deflector can be used to transfer a carrier from the conveyor belt onto the cryostats by means of superconductors, and the carrier can then be moved by hovering while coupled to these – even beyond separating elements and walls.
One possible application of this principle is to decouple individual transporting slides from a finishing process in order to move into a clean room with them without contact or to process the objects on them with gases or liquids in a sealed area.

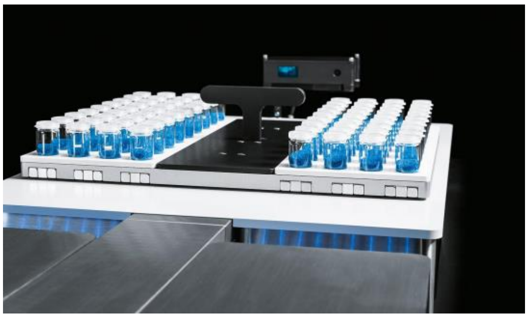

Fig.7.4. Supra Carrier

E. SUPRAJUNCTION:

The magnetization created below is used for transportation of objects can be achieved beyond enclosed surfaces and through locks. Two support plates hover above the superconductors; this is thanks to magnetic rails fitted underneath them.

Fig. 7.5. Supra Junction

They transport small glass containers on a circuit, whereby they are transferred from one superconductor element on a transport system to the next element on another handling system. During the contactless transfer from one cryostat to the other, an electromagnet that is fastened to an external axis pulls the support plate to the next cryostat in the working direction of the magnetic rails. For the first time, Festo thus achieves the automatic transfer from one system to another on the horizontal plane and enables hovering transportation in long process.

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AUTOMOTIVE MECHATRONICS

Rishikesh Karmalkar (Mech V)

I. INTRODUCTION

A large share of automotive innovations consists of significant improvements in formerly pure mechanical systems which are made possible using integrated electronics together with complex information processing. Such mechatronic systems require a concurrent design of mechanical, electronic, and information processing sub-systems in order to reach the cost requirements of the automotive industry. Here "The motivation for the use of mechatronics is discussed, as well as the most important technological challenges of the mechatronic approach. Mechatronic solutions for different automotive applications are presented."

The driving factors for future development of mechatronics in the automotive sector are discussed. In the recent past and in the foreseeable future, most innovations in automotive systems rely on electronics. Those innovations are rarely pure electronic systems for information processing and communication - like the mobile phones or navigation system - but most of them are closely tied to mechanical parts of the system. The three major mechanical subsystems in a car, the chassis system, the propulsion system and the interior system, all are undergoing a massive change from mainly mechanical systems with some electronic control towards highly integrated mechatronic systems which would not function without electronic control.

In vehicles, a large number of systems are undergoing a change from pure mechanical systems to mechatronic systems. In the following, some examples of typical automotive mechatronic systems are discussed.

II. CHASSIS SYSTEMS

The most evident development is seen in chassis systems. Since many years, systems like ABS (Anti Blocking System) and ESP (Electronic Stability Program) are standard in Mercedes and many other vehicles and have proven to reduce the number of driving accidents significantly. In the Mercedes SL and also in the E-class a new electrohydraulic brake, SBC (Sensotronic Brake Control), has been introduced recently. In normal operation, the power for the brake comes completely out of an electrohydraulic system and is controlled completely electronically. The system performs a lot of functions which a normal brake cannot do, such as drying of wet brake disks, preconditioning for emergency braking, and thus reducing the distance to come to a standstill by several meters. For faulty conditions a hydraulic fallback function is built into the system. Besides the brakes, the suspension is turning active in high end vehicles. ARS (active roll stabilization) for the compensation of roll movements during fast cornering is especially useful for relatively tall vehicles.

The far end of active suspension systems is the ABC (active body control) system in series production in the Mercedes CL and S class, which compensates for pitch and Scroll forces and which also controls the body vibrations caused by road roughness. For the steering function, systems which change the steering transmission ratio as a function of driving speed are being introduced into the market. More sophisticated steering systems, which automatically compensate for lateral wind and which help in stabilizing the vehicle during extreme driving maneuvers by compensating for under or oversteer are under investigation.

III. DRIVE TERRAIN SYSTEMS

The throttle is no longer operated by a pulley in many cars, but an electric actuator controls the air input to the engine. Injection systems rely not only on complex software in the engine controllers, but also the injectors themselves become more and more sophisticated. Ultra-fast acting piezo-electric injector actuators allow up to five independent injections per combustion cycle for optimized engine efficiency. Exhaust gas recirculation from the exhaust side to the air intake side in certain operating conditions will further reduce emissions. The angular position of the cam shaft and thus the opening and closing timing of the valves with respect to the cylinder position is another degree of freedom in engine control

Fig 8.1. Drive Train System

For the future, even more complex systems like electromagnetic valve control – only possible with sophisticated speed and position control of the valves (Streaky, 2001) – are under consideration for further improvements in fuel consumption and emissions. Using electric motors, which can lean softly complement the engine´s torque to give the required total torque, the engine will be stopped at vehicle stand-still and reactivated instantaneously upon restart. Complex power management, including battery state-of-charge monitoring, is a key feature for the control of such systems if they should not be oversized to inhibitive cost. Fans, pumps, and compressors will no longer be directly driven by the engine, because they will consume too much energy under normal conditions, but the best mechatronic solution for these systems is still under investigation. Variable and even electrically supported turbo chargers are another approach to enhance engine behavior at the borders of the operation conditions. Automatic transmissions, which up to recently relied on complex hydraulic control systems, are being transformed into mechatronic units. Manual transmissions are being automated with complex actuator and sensor systems in order to give a similar shifting comfort compared to their hydraulic counterparts, but with a higher efficiency

IV. INTERIOR & COMFORT SYSTEM

In the interior systems the climate comfort is one primary field for mechatronics. Fans, heaters, compressor and air duct flaps are controlled based on many sensors for temperature, sun position and intensity. The folding hard top roof systems – in the Mercedes SL 11 actuators are coordinated for its precise and fast motion– is another example of a mechatronic solution for the market´s requirements. Headlamps are turned on and off according to light conditions; their lateral lighting angle is controlled depending on steering angle and in future even using the information of the navigation system. Developments for active vibration damping in the vehicle are made and systems with optimized adaptive seat damping using rheological fluids are offered already for commercial vehicles. The wide field of restraint systems becomes also more and more complex with adaptive airbag deployment, use of resettable safety systems like belt tensioners, and out-of-position sensors. The Pre- Safe feature of Mercedes S-class even adjusts seat actuators if sensors indicate an accident is imminent and the passenger´s position is not optimal.

Fig 8.2. Folding hard top roof systems

V. ELECTRONICS AND EMBEDDED SOFTWARE

The large number of electronic control units (ECUs) in the vehicle – more than 30 in luxury vehicles – is caused by the fact, that for almost every new function a separate control unit has been created. This is a result of the commonly used development processes which – in order to handle responsibilities, testability, and supplier diversity – redraws hardware segmentation according to the different functions. share of electronics is a limiting factor for this style of hardware segmentation. New ways of implementing the functions into bigger chunks of electronics hardware is a necessity to keep the cost within bounds at ever increasing need for computing power. A very important key is the use of structured multi-source software development tools and provisions for safe memory sharing of code from different suppliers. In order to implement electronics – for cost reasons – on one single circuit board together with sensors and actuators, the electronics has to move from a well-protected location to places with increased requirements on temperature range, shock & vibration levels and other environmental impacts. This pushed the development of high temperature electronics within the last years. Another approach to save cost and space in ECUs is the distributed implementation of electronic components on flexible substrates, such as flat cables.

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[1] Automotive Mechatronics
URL-
https://www.researchgate.net/publication/223820620_Automotive_mechatronics

[2] Applications of etas solutions
URL-
https://www.etas.com/en/products/applications.php

STUDENTS ACHIEVEMENTS

2017-2018

Sr. No.	Name of the Students	Name of Competition	Date
1.	Aby Mathews	AIESEC'S National Leadership and Entrepreneurship Summit	04-01-2018 To 10-01-2018
2.	Aditya Patil	Mock Interview, Jamboree, ISHRAE Held At SCOE	13-01-2018
3.	Kedar More Ahi Sanju Sameer C Ninad Gholap Harshit Singh Noel Sabu Keyur Sanghwi Priyan Kamble	Robocon, National Robotic Contest Held at Pune	01-03-2018 To 03-03-2018
4.	Blesson Biju Noel Louis	CAD Challenge Organised By ISME, Held At DJSCOE	20-03-2018 & 21-03-2018
5.	Raymond Lopes Saurbh Patil Swapnil Lad Mathew T.	Blood Donation at AADHAAR Blood Bank	11-08-2018
6.	Aditya Patil	ISHRAE Student Technical League	2017-2018
7.	Abhishek Shinde	Student Membership, ISHRAE Mumbai Chapter	2017-2018
8.	Aditya Patil	National Level TPP Held At SIES, Nerul	01-03-2018
9.	Aditya Patil	National Level TPP Held At BVCOE	06-03-2018 & 07-03-2018
10.	Aditya Patil Renju Jose Dinoy P.	National Level TPP Held at Terna, Nerul	13-03-2018 & 14-03-2018

ACHEIVEMENTS IN CALIBRE 2K18

Sr. No.	Name of the Student	Event	Prize
1	Jitesh Shastri Deepak Bhole Sebastian D'souza	Aquaton	First, Crown of Beauty
2	Mayur Vadhel Vishal Patil Aishwarya Harad Shraddha Barbade	Battle of Bridges	First
3	Ruturaj Chavan Sumit Poojary Kunal Divekar Cinerita A.	Battle of Bridges	Crown of Beauty
4	Shalon Monteiro Abey Matthew Shubham Kavitkar Sumit Bhujbal	Cannon Ball	First
5	Ronald Joseph Nikhil Dalvi Justin Jolly Nathan D'Mello	TPP	First
6	Kedar More Vaibhavi Patil	TPP	Second
7	Jerine Jojo Khardenavis Amaiya Rajput Subhanshu Singh Karunakaran Rakeshkumar	Poster Presentation	First

ACHEIVEMENTS IN SPORTS

2017-2018

Sr. No.	Name of the Students	Name of Sport	Prize/Position/ Rank	Date
1.	Nimish Thube	Chess, All India Dombivali Kalyan Open International FIDE Rating Classical Chess Tournament	Best Unrated Player 27^{th} Rank Rs. 10,000/- Prize	30-01-2018 To 04-02-2018
2.	Roy Viegas	Badminton, SKREAM, KJCOE	Semi Finalist	06-02-2018 To 10-02-2018

ACHEIVEMENTS IN TECHNICAL COMPETITIONS

2017-2018

Sr. No.	Name of the Students	Name of Competition	Prize/Position/ Rank	Date
1.	Shyamranjan Mishra	Debate Competition at Z Art Alpha	First	26-07-2018 & 27-07-2018
2.	Anvay Joshi	ISHRAE Student Project Grant	RS. 50,000/-	21-10-2018
3.	Shreyas A. Aditya N.	National Level TPP, ISTE Student Chapter Prakalpa' 18, KJCOE	First	16-03-2018 & 17-03-2018
4.	Kedar More	National Level TPP, Infinity 2K18 Held At BVCOE	Third	06-03-2018 & 07-03-2018

PLACEMENT DATA

SR NO	NAME OF THE STUDENTS	COMPANY NAME
1	Garje Sagar Sominath	Godrej
2	Najid Tawfiq Tisekar	Godrej
3	Parija Anil Waghule	Godrej
4	Amey Pawar	Godrej
5	Shaunak Phansalkar	Swegon BlueBox
6	Simon Fernandes	Selec Control
7	Roshan George	Selec Control
8	Sarvesh Hariharan	Jacobs
9	Surajkumar Suntha	Jacobs
10	Tayyabali R. Chaughule	Jacobs
11	Angela Sekar	TCS
12	Anvay Joshi	TCS
13	Tushar Khaire	TCS
14	Mathew Thomas	TCS
15	Shyamranjan Mishra	TCS
16	Mayur Pansare	TCS
17	Subhanshu Rajput	TCS
18	Ronald Joseph	TCS
19	Tayyabali R. Chaughule	TCS
20	Aniket S. Thorat	TCS
21	Vishnu Pillai	CN Water
22	Ronald Joseph	CN Water
23	Ronnie Shefard	CN Water
24	Tanmay Warrier	CN Water
25	Pranav Mapari	Anshu Tech
26	Aloysius Lobo	Saini Electricals
27	Brean Burboz	Saini Electricals
28	Shamika Pathak	Saini Electricals
29	Ankush Sadhu	Saini Electricals
30	Tejaswini Rane	Saini Electricals
31	Pranav Chaulkar	Kirloskar Chillers
32	Omkar Sawant	Cosmos Aircon
33	Tushar Khaire	Burns MCD
34	Atharva Inamdar	Humidin
35	Mathew Thomas	Byju
36	Sagar Nair	VVF Ltd.
37	Terrence Pereira	Balakrishna Tyres (BKT)
38	Swapnil Lad	Balakrishna Tyres (BKT)

LIST OF TOPPERS

Toppers in Semester VIII		
Rank	**Name**	**CGPI**
1	Garje Sagar	9.78
2	Chaugule Tayyabli	9.76
3	D'Sa Joel	9.52
3	Suntha Surajkumar	9.52
Toppers in Semester VI		
Rank	**Name**	**SGPI**
1	Simran Dalvi	9.86
2	Kulkarni Siddesh	9.36
3	Mandar Rundekar	9.32
Toppers in Semester IV		
Rank	**Name**	**SGPI**
1	Yohann Lobo	10.00
2	Vishal Patil	9.88
3	Malwankar Omkar	9.46

SYNERGY 2017

SYNERGY is organized with the aim of bridging the gap between the industry and the institute and facilitates an effective interaction between them. This event provides an opportunity to the students as well as the faculty members to know more about the emerging technologies and methodologies adopted by the industry. Also, the industry in turn, gets to know the institute closely, thereby providing an opportunity to identify the value addition required to create high class professionals from the institute.

SYNERGY 2017 was conducted on 7th September 2017 with full enthusiasm and promptness. **GODREJ AND BOYCE** was the company that came and interacted with the students and the faculty members. Mr. Nikhil Vaidya (Assistant General Manager - Quality), Mr. Satish Ramavat (Associate Chief Manager - Design) and Mr. Sarvpriya Raj (Assistant Manager - New Product Development) were the dignitaries who graced the occasion with their presence and shared their technical experience and knowledge with students.

MESH 2018

MESH aims to introduce the recent trends in research and development, where research scholars or expert speakers from academia such as IIT, BARC, etc. are invited to deliver lectures in their area of expertise. "**MESH 2018**" was organized on 23rd February, 2018, under the aegis of MESA. Speakers were invited to deliver lectures for Mechanical Engineering students of semester IV, semester VI, and semester VIII.

The guest speakers who graced the occasion by their esteemed presence were:

1. Dr. S. D. Sharma (Professor, Aerospace Dept., Indian Institute of Technology Bombay, Mumbai). The topic of the seminar was "Vortex Formation and its control".
2. Dr. K. P. Karunakaran (Professor, Mechanical Dept., Indian Institute of Technology Bombay, Mumbai). The topic of the seminar was "Helicopters without Tail".

CALIBRE 2K18

MESA team of Fr. C. Rodrigues Institute of Technology in affiliation with Mechanical Department conducted a two-day technical fest on **23rd and 24th March 2018** named **CALIBRE 2K18** for the first time at the institute. It was conducted with a prime objective of allowing students of different engineering institutes to showcase their innovative ideas and collaborate with various other engineering students. This event allowed the students to showcase their skills and knowledge in the field of engineering and share their technical intellect through the physical models made by them and compete in this highly competitive engineering field.

On the first day of the fest i.e. on 23rd March, many exciting technical events were held, where more than **250 Under Graduate and Diploma students** from various engineering institutes actively participated with immense enthusiasm. The energetic and fun filled day included events like **Battle of Bridges, Aquaton, Quizophile, Robosumo, Cannonball** and **Torque** engaged the participants as well as the audiences with great interest and curiosity. All the participants entered the events with a decent potency and then there was an endeavoring contest among all the teams to win the prizes.

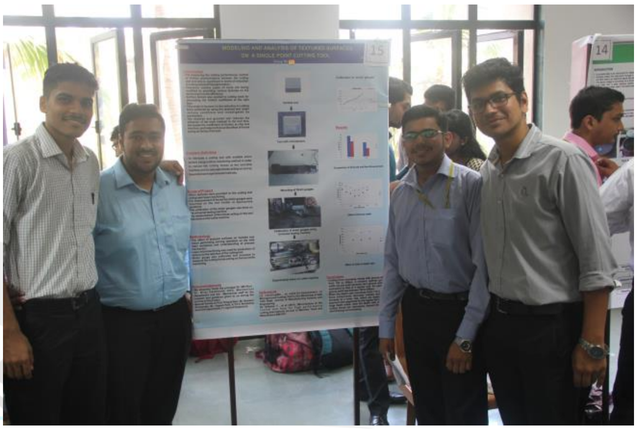
Carrying the same passion and excitement, on the second day i.e. on 24th March the most significant and arterial events of the fest were conducted - **A National Level Project Poster Competition** and **A Technical Paper Presentation Competition**. Based on the abstract of their project, about 30 teams for the Project Competition and about 20 teams for Technical Paper Presentation were selected. Students came with very unique ideas and preparations. The teams presented their models and technical papers and were judged on the basis of their efficiency and innovativeness. The best projects were nominated as winners.

The fest ended on the eve of the second day with a prize distribution ceremony. All the winners were felicitated with certificates and cash prizes and the participants were encouraged with participation certificates. Principal, Dr. S. M. Khot and Mechanical Department HOD, Dr. Nilaj Deshmukh congratulated all the participants and encouraged them with their well-wishing speeches. The dignitaries and guests also appreciated all the participants through their speeches.

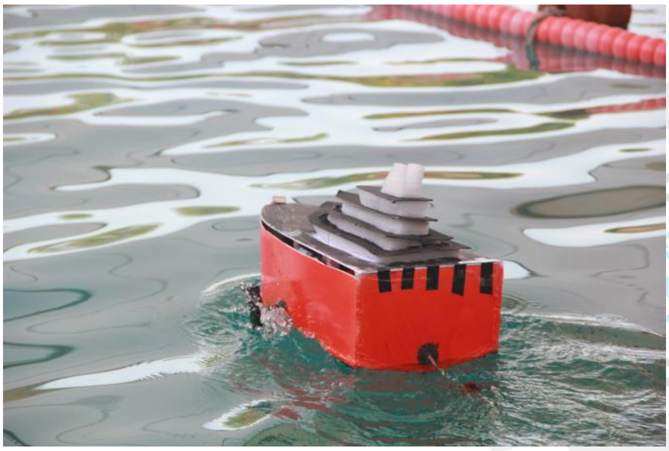
This was a wholesome event bringing together engineering students under the banner of research. MESA team with a precious help of all the volunteers of second and third year under the guidance of MESA coordinators and the faculty and non-teaching staff members, of Mechanical Department made this event a huge success. Their matchless efforts will definitely prove worth in bringing all the events like CALIBRE 2K18 to a better reality in the coming academic years in the institute.

ROBO SUMO

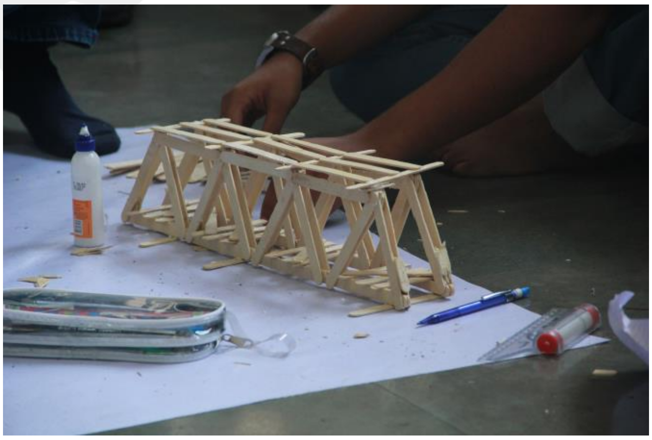
TECHNICAL PAPER PRESENTATION



PROJECT POSTER COMPETITION



AQUATON



BATTLE OF BRIDGES

CANNONBALL

CALIBRE 2K18: THE JOURNEY

BY- POORVA KHARE (PRESIDENT, MESA 2017-18)

It all began with an idea…….
A naïve thought and an unachievable dream.
"Let's do it"
A fest of our very own. A grand gesture to represent the mechanical passion beating in our hearts.
A team of 22. It meant different things to everyone. For some, it was a platform to showcase their talent; for some, it was a step to building their career. But for me, it was a chance to prove; To myself and the countless others who didn't believe in us. To prove to everyone who thought MESA was just a school of puppets. To those who believed MESA could never break the restraints.

The First Meeting

There were 22 heads at work. Each one had their own dreams about the face of this fest. Sponsorships, Promotions seemed like mere words to us then. Little did we realize; the road was just going to get slimmer and the times even more difficult. Ultimately Seven events won the battle with fifteen others.
And then rose the big question. How were we going to fund this?
A huge budget stood in front of us like the Everest. But we never gave up hope. Meetings went by and we faced rejections after rejections. We had no answers to give; time was flying by, 2017 swiftly coming to an end. But the new year brought hope and finally we got some support. It was a small amount. But it was a start. We had our first sponsor. Our belief in ourselves strengthened. Preparations received a new boost. Everyone was putting their heart and soul into it.
Our confidence rose with each new meeting and money started flowing smoothly.
Posters were made, invitations were sent. We were all like small ducklings, wading through muddy waters for the first time.
After hour meetings long chats, heated discussions and the easy camaraderie we shared helped us pave our way.

Promotions

We wanted to share this event with everybody and not keep it locked within the college walls. All colleges received invitations. Each MESA member bunking a little (our very own little rebellion) and spreading the message.
Deadlines were set and now began the wait for response. Days were passing by without entries and we could see our hopes dwindling. Were all the efforts going to vain and all those months of hard work?
But then…. In the last week….
The entries started flooding in. We were overwhelmed by the response. Small groups with their small robots and mini packages of hope, so similar to us, entered the contest looking for the chance to prove.

The Day before

It was here. The big day was now just a day away. All of us working to the fullest of our extent. Budgeting, decorations, last minute preparations. Speeches were ready. All the event venues were checked and made all set with the props. Prize money was ready. The only thing troubling us was the nervousness and the wait of the next sunrise. All hearts catching the fastest beats. I don't think any of us got any sleep that night….

The Big Day

23rd March: Calibre 2K18 -Day 1

The day started. Everyone was all set to go for that big day.

Aquaton was the first of the events to start. It began at 9:00 am in the morning by the swimming pool. The event of bridge building and robosumo followed and started simultaneously. It was so amazing to see all the creative minds set busy in constructing their own bridges with the sticks. The robosumos started their fights with all passion and power. The quiz too received a huge response. All those intelligent teams were determined to win.

Though there were small glitches, we overcame the obstacles and the day passed really smoothly.

We received a huge response. The deafening roar of the crowd over the quiz answers and the battling robots brought big smiles to our faces and motivated us to go happily for the next day.

The Second Day

24th March: Calibre 2K18-Day 2;

Day 2 arrived with a bang. 19 groups for the technical paper competition and 30 for the project competition. Each with their small innovations representing the future of the mechanical world.

Each group fought hard, some won the battle and the others won the confidence, to go further. The day passed by so quickly.

All of us gathered for the group photo and I was filled with a strange sense of despair. It was all over….

No more MESA meetings, No more after college discussions, No more small moments of happiness over the bunked lectures. I would forever cherish these memories.

I was a shy sophomore when it all began. MESA gave me my first identity in this college. A small acknowledgement in this sea of engineers.

I thank all those who helped me during this journey.

A shout to my team for supporting me through the ups and downs and standing by me throughout this small rebellion of ours!!

A big thank you to my coordinators for understanding us and having our backs throughout.

No camera is big enough to capture the memories I made in these past few months.

MESA PRESIDENT SIGNING OFF…….

ISHRAE COLLEGIATE CHAPTER

ISHRAE stands for Indian Society of Heating, Refrigeration and Air Conditioning Engineers. ISHRAE is an associate of ASHRAE, American Society of Heating, Refrigeration and Air Conditioning Engineers. In order to develop interest of HVAC&R (Heating, Ventilation, Air Conditioning and Refrigeration), ISHRAE society started student chapter in engineering colleges having Mechanical, Electrical and EXTC engineering branch. The ISHRAE student chapter of FCRIT started on 22nd September 2007. Prof. Nilesh Varkute & Prof. Badal Kudachi are the college staff coordinator for ISHRAE. ISHRAE organizes various events like Quiz, Technical Paper Presentation, Industrial visit etc.

ISHRAE also organizes 'JOB JUNCTION' placement opportunity for final year students each year. This year the ISHRAE Job Junction was successfully conducted on 26th, 27th, 28th of October at LTCOE, Navi Mumbai. A total of 1135 interviews were conducted for 268 students respectively. The students were segregated accordingly and 2 on-site online tests and 1 written test were conducted for 185 and 60 students respectively. The students those who cleared the tests were passed on for group discussions. A total number of 22 group discussions were conducted. There were a total of 13 interview rooms allotted and a command centre room was provided. At the end of a hectic three days schedule a total number of 68 students were selected for 35 vacancies. This year ISHRAE job junction has been a major success for our college. A total of 9 students from our institute were placed during the 3 days.

SAE INDIA

SAEINDIA is an affiliate society of SAE International registered in India as an Indian non-profit engineering and scientific society dedicated to the advancement of mobility industry in India. The founding principle of the SAE International is to unite scientific and technical staff to perform free academic discussions, to dedicate themselves to the cause of prospering the science and technology for automotive vehicles and to make contributions to speed up the modernization of automotive industry. SAEINDIA is a professional engineering society whose membership represents practically every engineering and scientific discipline. Its members combine their specialized abilities to further advance the research, development, design, manufacture and utilization of vehicles which operate on land, water, air and space.

The Club actively organizes events various such as TORQUE- Intercollege event of Nitro Racing and SPARK- Seminar by speaker from automobile sector. Prof. Girish Dalvi and Prof. Aqleem Siddiqui are the Faculty advisor for SAEINDIA. The Department has a SAE Collegiate Club of SAE, having 50 members.

FACULTY PROFILE

Dr. S. M. Khot	**M. E. (Shivaji University) -** Mechanical Design Engineering **Ph.D. (IIT BOMBAY)** **Principal** Professor (Exp. - 29 years) Area of Research - Mechanical Vibration Dynamics and Control, Active Vibration Control, Smart Structures
Dr. Nilaj Deshmukh	**M. Tech. (VJTI, Mumbai) -** Automobile Engineering **Ph.D. (IIT Bombay)** - Aerospace Engineering **HOD and Dean (Faculty)** Associate Professor (Exp. - Industrial 2 years, Teaching - 18 years) Area of Research - Virtual instrumentation, Combustion, Combustion Instabilities, Measurement Techniques, Noise Analysis, Aerodynamics
Prof. T. Mathewlal	**M. S. (BITS, Pilani)** **B. Tech. (Mechanical) -** Systems Associate Professor (Exp. - 29 years) Area of Research - Engineering Mechanics and Thermal Engineering
Dr. Nitesh P. Yelve	**M. Tech. (VJTI Mumbai) -** Machine Design **Ph.D. (IIT Bombay, Mumbai)** - Aerospace structures **Dean (PG Studies)** Associate Professor (Exp. - 16 years) Area of Research – Structural Health Monitoring, Active vibration control, Structural Dynamics, Design of Experiments Using Statistical Methods, Composite Materials

Dr. Nitin Satpute	**M. E. (SPCE, Mumbai)** **Ph.D. -** (Mechanical Engineering) Associate Professor (Exp. - Industrial - 4.5 years, Teaching - 13 years) Area of Research – Vibration, Mechatronics, Design, FEA
Prof. N. G. Kshirsagar	**M. Tech. (VJTI Mumbai)** - Machine Design Assistant Professor (Exp. - 20 years) Area of Research – Design, MEMS, Synthesis of Mechanism
Prof. Aqleem Siddiqui	**M. E. (Mumbai University)** - Machine Design **Ph.D. Pursuing (Mumbai University)** Assistant Professor (Exp. - 19 years) Area of Research - Active Vibration Control, Statistical Methods and Design of Experiment, Automobile Engineering
Prof. Prasad Bari	**M. Tech. (VJTI, Mumbai)** - Production Engineering Assistant Professor (Exp. – Industrial - 5 years, Teaching - 11 years) Area of Research - Micromachining
Prof. Sanjay Rukhande	**M. E. (SPCE Mumbai)** - Machine Design **Ph.D. Pursuing (VJTI, Mumbai)** Assistant Professor (Exp. - 17 years) Area of Research - Design, Analysis, Finite Element Method
Prof. Shamim Pathan	**M. E. (Mumbai University)** - Machine Design Assistant Professor (Exp. - 10 years) Area of Research - Vibration and Vibration Measurement, Condition Monitoring
Prof. Bipin Mashilkar	**M. E. (Mumbai University) -** CAD/CAM and Robotics Assistant Professor (Exp. - 11.5 years) Area of Research - CFD
Prof. Pallavi Khaire	**M. E. (Mumbai University)** - Machine Design Assistant Professor (Exp. - 10 years) Area of Research - Mechanical Vibration and Machine Design

Prof. Santosh Chauhan	**M. E. (Mumbai University) -** Machine Design Assistant Professor (Exp. - 10.5 years) Area of research - Optimization, Design of Experiments
Prof. Praseed Kumar	**M. E. (Mumbai University)** - Machine Design Assistant Professor (Exp. – Industrial - 8 years, Teaching - 10 years) Area of Research - Active Vibration and Control, Control Systems, Smart Materials
Prof. Kamlesh Sasane	**M. E. (Mumbai University)** - Machine Design Assistant Professor (Exp. - 10.5 years) Area of Research - Design Analysis, Mechanical Vibrations, Automobile
Prof. Deepak Devasagayam	**M. E. (Old Dominion University, US)** - Mechanical Engineering Assistant Professor (Exp. – Industrial - 5 years, Teaching - 7 years) Area of Research - Manufacturing, Production
Prof. Nilesh Varkute	**M. E. (Mumbai University) -** Thermal Engineering Assistant Professor (Exp. - 9 years) Area of Research - Computational Fluid Dynamics and Heat Transfer
Prof. Girish Dalvi	**M. S. (Polytecnico Di Milano, Italy)** - Mechanical Systems Design Assistant Professor (Exp. - 8 years) Area of Research - Vibration Measurement and Analysis, Virtual Instrumentation
Prof. Shraddha Patil	**M. Tech. (VTU, Belgaum)** - Design Engineering Assistant Professor (Exp. – Industrial - 1 year, Teaching - 8 years) Area of Research - Design
Prof. Suvarna Rode	**M.E. (Mumbai University)** - Machine Design Assistant Professor (Exp. – Industrial - 3.5 years, Teaching - 9.5 years) Area of Research - CAD/CAM, Smart Material and Structures

Prof. Badal Kudachi	**M. Tech. (VTU, RC, Mysore)** - Thermal Power Engineering Assistant Professor (Exp. – Industrial - 6 months, Teaching – 4 years) Area of Research – Renewable, Thermal Barrier Coating, CFD
Prof. Akshay Vasant Mastood	**M. Tech. (Automotive Technology)** (Exp. - Teaching - 2 years, Industry - 6 months) Area of Interest - Non-conventional Fuel Technology, Hybrid /Electric Vehicle.
NON-TEACHING STAFF	
Mr. Sayaji Atole	Lab Assistant
Mr. Sandeep Arote	Lab Assistant
Mr. Pankaj Wavhal	Lab Assistant
Mr. Pravin Patil	Lab Assistant
Mr. Narayan G.	Lab Assistant
Mr. Sanjay Junonikar	Lab Attendant
Mr. Rego Menezes	Lab Attendant

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