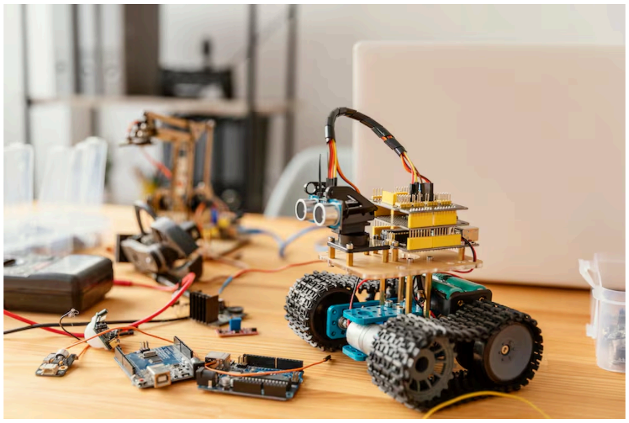
Robotics

Lecture #1: What is Robotics?

Robotics is an interdisciplinary field. It's a combination of several Engineering Disciplines, such as Electrical, Electronics, Mechanical, Computer Sciences (AI, ML, DS etc etc.). Many assume it to be mostly core related, but it actually isn't. It's half Core and Half Technical. The core can only be used to make the skeleton, but it cannot give it a thought capable brain. So Buckle up, we'll head straight into the Roadmap of how you can start in it.



Before that, It is my sincere suggestion that the use of AI for Programming be as Minimized as possible. Learn and Understand what you do, Only then will you start loving it. It'll seem difficult, boring and slow, but that's what makes the results sweeter. Understand the basics, and the rest will come to you pretty easily.

Lecture #2: Roadmap

As mentioned earlier, robotics is a combination of multiple Engineering Disciplines. Hence, it is important to know which of those disciplines do you belong to, or would like to go into. For starters, Let's go into what each disciplines role is

- **Mechanical Team** - This team is responsible for the design of the robot. They design and make the skeleton/Base. They also ensure that the Robot maintains proper Structural Integrity during its required role.

- **Electrical and Electronics Team** - They are Responsible for Electronics parts of the Robot. Sensors, Microcontrollers, Power Distribution and Regulation, Control Systems, Communication Systems etc all come under these.

- **Software Team** - They make the bot think. They integrate all the data read from the sensors and other electronic components and convert it into the required logic. They also work closely with the Electrical and Electronics Team, assisting them with programming and Microcontroller and Microprocessor Selection.

2.1 Mechanical Dept.

As of now, Mr. Homeless hasn’t really dabbled in the Mechanical team, but he can tell you what he knows.

- Start with basic Core knowledge. Take a look at Practical Physics.
- Start Designing. Use any software you like, can be SolidWorks, Fusion 360, AutoCAD, but start it. It gives you experience and increases your creativity. For SolidWorks, the playlist below would be a great start.

  https://youtube.com/playlist?list=PLXq_A5oBY0KWcluFQ-pCvie9LL5uw0OxV&si=w-HzA0Xv-mCzyJVk

  The playlist helps you understand what various functions are available in the Software, and gives you the idea of how you can use them. Other than this, it’s mostly practice. Try Designing random things that you see, understand why they’re designed in that way, what factors were taken into consideration etc.

2.2. Electrical and Electronics Dept. + Software Dept.

For those interested in the Electrical and Electronics team, here is what you all should follow, At least in Mr. Homeless’s Opinion.

1. Learn and Understand Basic Electrical and Electronics. Refresh your knowledge of basic Electrical theories and Laws. These include Ohm’s Law, Kirchoff’s Law, Series-Parallel Connections, Voltage and Current Divisions, Network Theory, Electronics Components, how they work. You don’t need to learn all of them or learn them completely, but just enough to understand the basics. This is so that you don’t accidentally blow something up (Electronics can be very expensive!)
2. Start with Microcontrollers. The Arduino Uno is a very good start. Though people and judges in competitions might say that it’s become obsolete, It is nonetheless, one of the best Microcontroller boards for learning. It has had huge community support and Documentation. So much so that you’ll find a huge number of resources on it.

   The video below will help you understand most of the above mentioned topics:
   Arduino Course for Beginners - Open-Source Electronics Platform

3. After you get an understanding of them, I’d recommend you start making basic projects. The Playlist below can help you greatly in building projects.
   https://youtube.com/playlist?list=PL4g1oAdmuCfqmYvURLzVFkMMUI7839biN&si=CYezgsoAZXN3M2mB

For those who find it difficult to buy or get electronics (we broke, shi is expensive), you can use Online tools such as TinkerCAD to simulate them. This also can be useful for the mechanical guys as well.

4. This is after you do some basic level things on the Arduino. Try using the ESP32 Boards. They'll be game changers for your projects. They've got Wi-Fi, Bluetooth, and RTOS capabilities. Try doing projects that utilize these. The Playlist below will help a lot in understanding what you can use your ESPs for:
   https://youtube.com/playlist?list=PLWNDWPAClRVqNUIuJylljkQfFSeIpuxUi&si=FwiUDzlN6VxpgKh6 (ESP32)
   https://youtube.com/playlist?list=PLEBQazB0HUyQ4hAPU1cJED6t3DU0h34bz&si=rbDkeBuBQP_9aB2A (RTOS)
5. Try implementing ML Models on the ESP32 using libraries like TinyML. Use some of the videos from the playlist below:
   https://youtube.com/playlist?list=PLp1g3fyrnmBNehtqyPsrJY-gYQKH90ZPH&si=sOfIshKRzOYRMSxh
6. While you're at it, try experimenting with different Communication Protocols, such as UART, I2C, CAN, SPI etc. These give you a greater understanding on how you can collect data or integrate electronics. Try using sensors like the IMU as well.
7. This is mostly for the Electrical and Electronics guys. Learn Circuit Designing and PCB Designing. Use Softwares such as KiCad, EasyEDA, Eagle to make Circuits Schematics and PCB design for your projects. This is quite important when you go into making larger robots.

At this point, try making a Line Following bot, like the one we see in reels (the super fast ones). Also, if you want to go more into microcontrollers, Step into STMs. They are the Microcontrollers actually used in the industry. But you'll also need a solid understanding of electronics to actually use them, since they are mostly used in self developed Boards.

8. Try to make some Projects with the Raspberry Pi as well. The Playlist below will help you on how you can interface electronics with Raspberry Pi
   https://youtube.com/playlist?list=PLLSegLrePWgLzBgQqDJvgZ4ewbpCnuare&si=pVE4VR-GCIrQ9YdL
   https://youtube.com/playlist?list=PLGs0VKk2DiYxdMjCJmcP6jt4Yw6OHK85O&si=ts8cCjbnaetI2p-y
   Choose either of the two playlists, depending on your understanding and learning capability.

These playlists should contain some very basic things such as controlling LEDs. Understand the concepts, so that you'll have an easier time doing your projects, and won't be completely blind.

For those interested in the Software, Try integrating ML Models, Deploying AI, and making the bots Semi-Autonomous. Try Deploying Apps that link to Raspberry Pis and ESPs. Try using Cloud Services in your projects. The sky is the limit!

Lecture #3: ROS

If you want to go deeper into Robotics, learn ROS2 (Robot Operating System). Its what makes a Robot truly Autonomous. Mr. Homeless won't divulge much in this, but speaking from experience, Mr. Homeless would suggest you start this once you finish all the above things and are proficient in OOPs (Object Oriented Programming). The Playlists that Mr. Homeless found helpful are linked below:

https://youtube.com/playlist?list=PLLSegLrePWgJudpPUof4-nVFHGkB62Izy&si=J3Mwb6MCr_RhDxDz

https://youtube.com/playlist?list=PLunhqkrRNRhYYCaSTVP-qJnyUPkTxJnBt&si=IUjdTlFG2UgejVsn

https://youtube.com/playlist?list=PLunhqkrRNRhYAffV8JDiFOatQXuU-NnxT&si=37eBW7wiXx7rV4vB

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