Electronics Club

Task 1

About the Club and the Club's Spirit.

Congrats again on becoming a Part of Electronics Club 20-21.

Electronics Club as such works with many diverse Technologies. Last year we explored with Virtual Reality and the previous year on LiFi and we will continue to do so in the coming years also.

I cannot stress this enough and will keep stressing this statement throughout my Tenure. Electronics Club is not just about Electronics, It's about taking responsibility, the spirit of Problem Solving and curiosity to learn new skills.

Also Here Are Some Interesting Questions to start with, I once had these questions and I found these questions interesting :

- Remember the Video game Duck Hunt, the one where we have a gun and keep shooting at Birds on the TV? How does it work, and with the game being super famous world-wide and now that we have higher-resolution LCD/LED TV Panels, Why can't we play Duck Hunt in them?

- All of us have seen Resistors, They have very specific random values like *100, 120, 150, 180, 220, 270, 330* and why do they have these values instead of rounded values?

Details about the Mini-Task

I've added as many Hyperlinks as I can so as to make sure I can provide enough references, But Remember most of it can be found by a *Simple Google Search*. If you have a problem with a library or a software version, I would request you to try out alternative ones and try other approaches of solving the problem before contacting Me or Praveen, Also while going through Answers to solutions make sure you understand them in detail in a recursive fashion which means, If a Page contains *" We use I2C as a means to communicate between Microcontrollers... "Than* First find out what are all the ways you could communicate between Microcontrollers and where it is used, and then try understanding what I2C is and how it is compared with other protocols and then keep going till you understand whatever they are doing completely.

Deadlines for the Mini-Task

- Mini Task-1: 29th April 11:54 pm
- Mini Task-2: 4th May 11:54 pm
- Mini Task-3: 10th May 11:54 pm
- Mini Task-4: 15th May 11:54 pm

How to Submit the Mini-Task :

You will have to create a Github Repository for Each task and Keep Documenting your work in it. After Each Task is Done, There will be a Thread in Slack Channel where you can post the repository link and everyone gets to go through your repository.

Mini-Task 1

Why Should you do this task? Because as much as important learning new things are, It is very important that you document it. I have personally been benefited a good number of times because I chose to document my code/work. Here is an example of documentation for one of my work.

Getting Started with Github :

- Create a Github Account using your Smail.
- Create a Repository and Edit its README.MD File
- Keep Documenting your work into your Repository.

You would need to select at least 25 Distinct Projects **on strictly** different Domains and understand them **thoroughly.** (If asked any details about it, you need to be able to answer it with appropriate reasons) .

Some Websites which Contains Electronics Projects are :

- Instructables
- Hackster.io
- Hackaday.com
- etc...

The 25 Different projects should satisfy these criteria:

- They shouldn't be in the same domain.
- The Project should be of Medium-Hard Difficulty to make.
- At Least 10 projects out of the 25 shouldn't include Arduino.
  (Because Electronics is more than just working with Arduino)

What to Document :

- You will be adding a brief description of all the 25 Projects in your Github Repo and add some personal notes/comments on that project.
- For At Least 5 Projects, Add Images for it along with the description.
- For At Least 3 Projects, Add GIFs for it along with the description.

Example : (Difficulty, Diversity should be of this level)
If I was Asked to Choose 5 Projects in Different Domains satisfying the Conditions, I would choose something like this.

- Receiving Images From Passing Weather Satellites (NOAA and METEOR M2) Using a Cheap SDR
- A Game That Learns How to Play Itself
- OctaPi - Raspberry Pi Supercomputer/Cluster
- Hard disk Hacking
- Gesture Controlled Drone - My Personal Project (MYO + ROS)

Learning Outcomes :

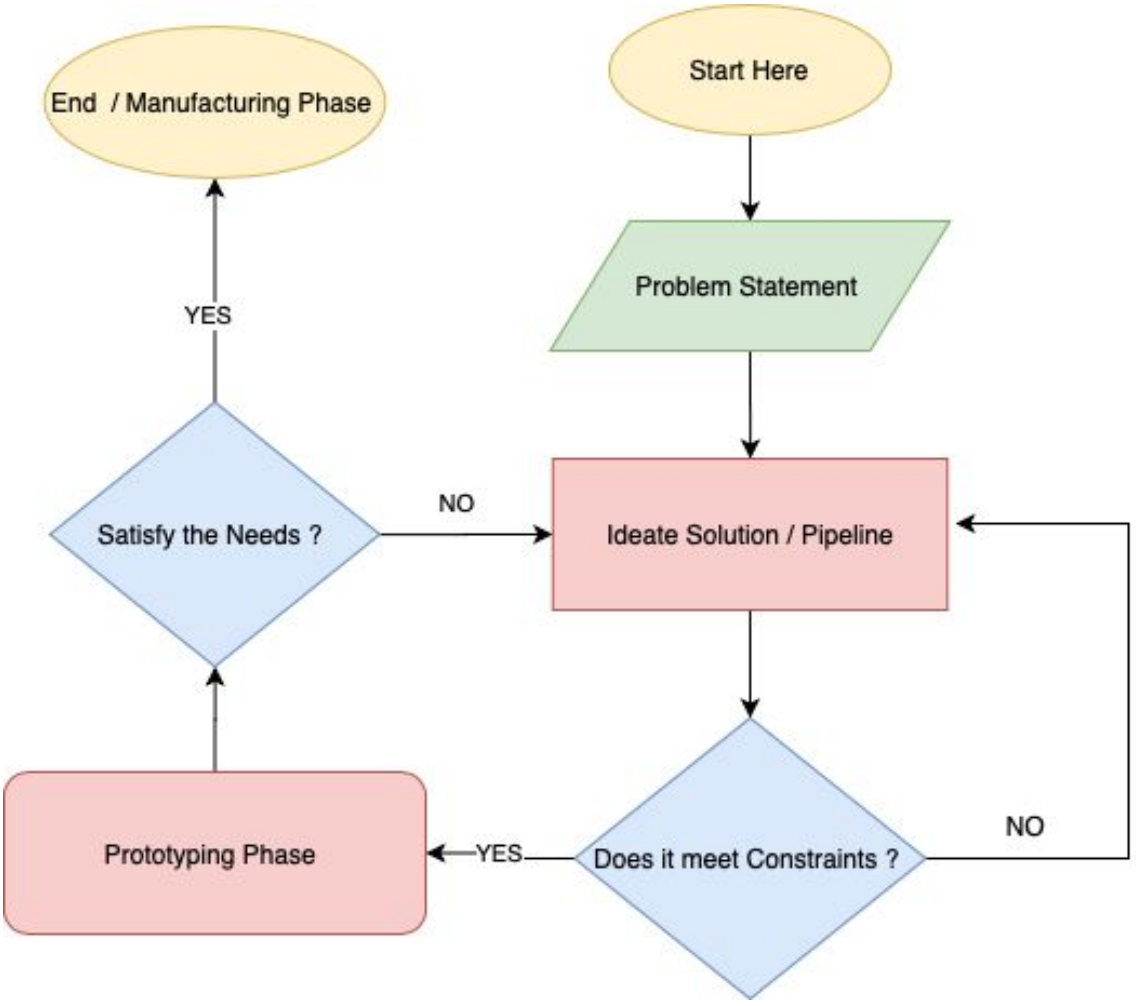
- While browsing multiple projects you get to learn about different approaches to problem-solving.
- You get to **compare between components** and how you attach different components while working on Projects.

Mini Task-2

Again, Create a new Repository for this Task and add it to the Slack Channel Thread.

Here you will ideate on Project, Please go through the Notes and your Mini-task is present Below.

Some Notes about Project Planning :



To put in Simple Terms, This is how a project progresses over time.

- **Problem Statement:** *"If you define the problem correctly, you almost have the solution." - Steve Jobs*, Defining the Problem statement and the goals properly are the first state you start with, Later you may add more features, but without a well-defined problem statement, you cannot go anywhere.

- **Ideate Solution:** This phase is where you will spend a lot of time putting thoughts into Because In practice you will face constraints such as Size constraints, Budget Constraints, Resource Constraints, Time constraints etc... You would be defining a solution/pipeline taking into consideration all these trade-offs.

- **Prototyping phase:** This is the phase you've been waiting for, This is when you finally get your components and connect all the wires and code the microcontrollers and get it to work. Lots of time (> 80 %) of the time you would not get it working in the first attempt, you would then be reiterating if you've made a mistake with any of the constraints, else you would jump into Debugging and solve the problems.

- **End / Manufacturing phase:** Either the Project ends here if it was meant as a learning module, or it moves into the manufacturing phase, where more ideation and more constraints are laid out and the same problem is solved and mass-produced.

Here is an **Example** for Project on how I expect you to Ideate :

- Problem Statement: Hacking a Commercially Available Remote Control Toy Car to use it for Gesture Control.
- Ideation :
    - Understand the Car's Mechanism :

Buttons on Remote ⇒ Remote Microcontroller ⇒ Antenna on Remote

Radio Frequency Communication

Antenna on Car ⇒ Car's Microcontroller ⇒ Motor Rotations

- Which part of the Pipeline to Break :

Part of Pipeline to hack	Feasible	Advantages	Disadvantages
Button on Remote	Probably, Buttons are basically switches, so we can modify them	Very Cheap and Not a lot of components required.	Might not work if the designer made a very complex micro-controller for the remote
Remote / Car Microcontroller	Usually Hard, Unless very Skilled and experience	Very Cheap and easily programmable if can identify what to do	Very Hard for beginners and Datasheets are not found as the ICs are company-specific
Antenna on Remote / Car	Nightmare !!	You gain so much knowledge if you can do it.	Reverse Engineering this part is very hard if not experienced.
RF communication	Usually hard if you don't have the right equipment for the job	You can then not worry about one full car pipeline and the programming would be very easy	Need Dedicated Radio Equipment which costs a lot.
Motor Rotations	YES !!, The most Naive Way to do it	Because you have low level control, you can even customize it further	It costs more compared to the other ones.

- Choosing a Pipeline: From the Above, We can Either Choose **Button on Remote** or **Motor Rotations** to hack into.
  Button on Remote: Solder Wires onto the Remote and

Connect Arduino to send signals and see how it reacts
Motors Rotations: Buy All components except motors to make a bot and program it to make it work.

- This Choosing a Pipeline will also take into account on what all Components I will Use, I cannot use a 3.3V powered microcontroller when the Motor Driver uses 5V, and if I choose to use it, then I need to take care of some specific things, How would I take care of it? ⇒ **More Ideating on my Approach.**
- Now I will draft a list of components I will need for the project and get it and start working.

- **Prototyping Phase :**
  - I would now try to Build the Product in this phase and test and debug it.
  - Also, I might have some background assumptions which would fall apart during this phase, Now I go back to the Ideation Phase and work it out and do this recursively till I get it solved.

Each and Every Project can be broken down like this and made better.
Example in the First Task you might have noticed lots of people following these steps to construct their project.
We will see in-depth about Debugging in Mini-task 4.

Take at least **two projects** from the previous list and suggest better approaches to solve the same problem and argue why your idea is more feasible/easy to implement / cost-effective / least power consuming etc..

Draft it the same way or in a better way than I've solved in the example.

P.S.: Implementation of the Above Example I made 5 years back:
https://photos.app.goo.gl/KTgWRZfkiJuFifzq7

Mini-Task 3

This is Slightly More Fun than the previous ones, I will be putting up my Projects here and you get to criticize it / parts of it and suggest ways to make it better. But Also, I've thought well before constructing my Projects making it slightly hard for you to point out mistakes, but there are certainly some things which I could have made better, Point it out …. You can ping me to ask questions when you come up with a better design and your solution should be made from parts that are **commercially available**.

Project 1 :

This is something that I've made during my Second Semester ,this is a Ring like in Green Lantern where it would light up only when you wear it up. Here are some pics/videos on how it works :
https://photos.app.goo.gl/N8anv2Y11sroHiKh6

I soldered all of them directly on Button Cell Batteries and used Push Button as a Trigger to Turn it On / Off when a Person wore it. **But one problem I faced is that it was hard for you to wear it for a long time as the button constantly pushed your skin making it painful even if worn for a couple of minutes.**

Your task is to come up with a better way to make something like this, that can be worn on your Finger and have the feasibility to be made from products that are commercially available and doesn't hurt your fingers.

Constraints: Size and Power, It has to be powered by Button Cell because that's the smallest power source I could think of…. It also needs to be small, so I directly soldered all of them together without any extra wires etc …

Project 2: Control Systems for Reinforcement Learning - Hexapod

This is a project that started as an iBot-Elec Collaboration last year and is currently a Professor Project under Pratyush.

Here is a video that was presented at Open House 2019 and It explains what we Intend to Achieve.

https://photos.app.goo.gl/7kUCAC8m5KeQquuy6

In Reinforcement Learning, one important part of the pipeline is to detect the state of the system at all Instances, This Hexapod has 18 DOF, *Your task is to Integrate different Sensors to the Hexapod and recreate the exact orientation of the Bot in a Computer, How would you plan to do so.*

I expect the Answer to include Technical Details in Depth. You also need to make the Entire Pipeline on How you obtain the data from all these sensors and send it back to a Computer. What Microcontroller? Which Sensor ? and Why? What are the reasons you chose this specific one ? and How do you plan to Manage the Wires?

I am also working on Version 2 of the Hexapod at the Moment : https://photos.app.goo.gl/9QR5EfDU5imJLqe58

If your Solution is Good enough … I would certainly implement it.

Constraints: Price (Because CFI funds it), Reliability of the Data, Delay in the Information of data, Wiring Ideas (Check out the Video - If all 18 Motor wires were loose, it would get tangled and stop working)

Project 3 :

MicroMouse Maze - TechSoc Challenge :

Checkout the MicroMouse Maze Problem Statement :
https://drive.google.com/open?id=1A4k_j8yo-UkiDvE1oPCyYrLj1uW6IZLh
(Use SMAIL to access this document)

Here is my solution for that :
https://photos.app.goo.gl/7rQEti7YrkSpo1ug6

Approximate Dimension : 10cm x 9cm x 9cm

This dimension made it really good for us, As you have 3cm in both sides for safety, Along with this, We Implemented a Proportional Control System so that even if the Bot Moves to any direction, It would Self-Correct itself using the Sensor in the sides and the code we made.

I felt our Bot was the best when it came to components, and Considering all the Trade-off and constraints we needed to take care.
P.S.: It also slightly resembles a mouse (I carried the bot in a snack box to give it the Mouse feels :P)

Constraints: Budget - TechSoc has a budget and the cost of entire bot need to be under the Budget, Size - Checkout the Problem Statement, Sense of Position, We always needed to know where the Bot is in order for the Algorithm to work.

Your task is to come by with a better solution for the problem, All in Details, Comparing with my solution and arguing why it is better with respect to one or multiple aspects.

Here are the Components we used :

Microcontroller - ESP32
Power : iBall Power Bank 5V
Chassis : Made from General Purpose Circuit Board
Wiring : Jumpers
Sensors :
Sides - Time of Flight:
https://robu.in/product/gy-53-vl53l0x-laser-tof-flight-time-ranging-sensor-module-serial-port-pwm-output/
Front - Ultrasonic Sensor
Motors with Encoders:
https://robu.in/product/n20-6v-100rpm-micro-metal-gear-motor-with-encoder/
Code: Used Arduino IDE + Flood Fill Algorithm + Proportional Control for Straight Line Travel. (Hint: Arduino IDE Alternatives)

Project 4 : (Optional) (First 3 are compulsory)

Especially if you are also interested in Computer Vision or Deep Learning.

So, Inspired from the American game show, Indian Shopping malls have an Arcade gaming centre which has the game " Deal or No Deal ", Where the user needs to pick a box number after shuffling, but it is too fast for a human to track thereby, making the user play the whole game under luck, this also has a Time limit thereby taking a slow-mo video and tracking it manually makes it impossible, so our system finds the highest prize money of the game and keep track of the box and gives me the output in the end...

https://photos.google.com/share/AF1QipN9gDXCxyHEQmRB6wk2Z_-X3VLnCKIBkSIcbOte9kBsD4ihXTcrGMna-u0Kvq1H1g?key=dUJTTjhBQ1pXMEljRWNia1Zab21pS0dTYUNLS0ln

Here is the code if you want to take a look at it :
https://github.com/aswinkumar1999/deal_or_nodeal

Constraints: Real-time and needs to run on a Mobile Phone using the App Termux. So Can only use certain Libraries and needs to be multi-processed so that it works in real-time.

Ideate a Solution that you think would be real-time also in an Edge Computing Device.

Mini-Task 4

Debugging Basics and Pipeline :

It's evident that things don't work for the first time. So, One Important skill is knowing how to quickly debug the circuit/code.

For Each project Debugging is different but the similarities among all of them are the same. Breaking a big project into chunks and verifying each and every chunk and making sure it works. - Divide and conquer

Here is a Debug tutorial that I wrote for the Elec-iBot session from last year: https://github.com/aswinkumar1999/Elec_iBot_Session

Your task is to Choose the two projects that you chose in Mini-Task 2 and write the Debugging tutorial for it.

Make sure you explain it in detail and make sure you also write it in a recursive fashion.