ELP305: Design and Systems Laboratory

2020-21 Semester-II

Certificate of Work for Team B

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1. Team Members

Role	Name	Entry Number	Remarks
Lead Coordinator	Shauryasikt Jena	2018EE10500	Exemplar and excellent initiative, innovative, motivated and committed to best results
Activity Coordinator for Mechanical Requirements	Ishita Hans	2018EE30546	Excellent initiative, regular in delivering the requirements
Activity Coordinator for Electrical Requirements	Aniket Shetty	2018EE10443	Excellent initiative, regular in delivering the requirements
Activity Coordinator for Mechanical Specifications	Sakshi Bhandari	2018MT60792	Excellent initiative, exemplar resourcefulness
Activity Coordinator for Electrical Specifications	Anubhav Dubey	2018EE30529	Exemplar and excellent initiative and resourcefulness, an excellent asset to the team
Activity Coordinator for Design	Siddhant Priyam	2018EE30565	Exemplar and excellent initiative, motivated and committed to best results
Activity Coordinator for Design	Misha Mishra	2018EE30624	Exemplar and excellent initiative, motivated and committed to best results
Activity Coordinator for Documentation	Sharut Gupta	2017MT60250	Regular in delivering work, committed to ensure best quality
Activity Coordinator for Documentation	Shradha Nandkishor Rathod	2017MT10751	Exemplar motivation, regularly dedicated and committed to deliver best quality
Activity Coordinator for Design + Documentation	Uddharsh Kotahwala	2018MT10771	Exemplar initiative, innovative, resourceful, regular, an excellent asset to the team
Activity Coordinator for Design + Documentation	Shivang Seth	2018EE30563	Excellent initiative, resourceful
Team Member for Mechanical Requirements	Aditi Rai	2018MT10736	Resourceful, hard-working
Team Member for Mechanical Requirements	Kartikeya Rai	2018MT60811	Excellent initiative, resourceful, regular and hard-working

Role	Name	Entry Number	Remarks
Team Member for Electrical Requirements	Mridul Ahuja	2018MT10626	Excellent initiative, resourceful and hard-working
Team Member for Electrical Requirements	Himanshu Singh Yadav	2017MT10731	Resourceful, hard-working
Team Member for Mechanical Specifications	Ayush Srivastava	2018MT10747	Excellent resourcefulness, hardworking
Team Member for Electrical Specifications	Suhani Jain	2018EE10507	Excellent resourcefulness, hardworking
Team Member for Design	Adarsh Jain	2018EE30525	Exemplar initiative, hard-working, regular, an excellent asset to the team
Team Member for Design	Silky Singh	2018MT10769	Exemplar initiative, innovative, regular, hard-working
Team Member for Design	Kartik Agrawal	2018EE10472	Exemplar initiative, hard-working, regular, an excellent asset to the team
Team Member for Design	Digvendra Singh Tomar	2018EE30539	Exemplar initiative, hard-working, regular, an excellent asset to the team
Team Member for Design	Rachit Mittal	2018MT10764	Resourceful, innovative, hard-working
Team Member for Design	Bhumika Chopra	2018MT10748	Exemplar initiative, innovative, regular, hard-working
Team Member for Design	Kushagra Singh Saini	2018EE30553	Resourceful, hard-working
Team Member for Design	Kushal Gowda	2018EE10304	Exemplar initiative, hard-working, regular, an excellent asset to the team
Team Member for Documentation	Hetvi Jethwani	2018MT10754	Exemplar initiative, excellent in innovation, regular
Team Member for Documentation	Palak Jain	2017MT10742	Regular, hard-working
Team Member for Documentation	Amogh Agrawal	2018EE10441	Regular, hard-working

Role	Name	Entry Number	Remarks
Team Member for Documentation	Anchit Tandon	2017MT10772	Excellent initiative, regular, hard-working
Team Member for Documentation	Shresth Mehta	2018EE30564	Exemplar initiative, innovative, resourceful, regular
Team Member for Documentation	Ichha Rathod	2018MT10755	Excellent initiative, regular, hard-working
Team Member for Documentation	Mihir Kedia	2018MT10227	Excellent initiative, hard-working
Team Member for Documentation	Utsav Singhal	2017MT60788	Excellent initiative, regular, hard-working
Team Member for Design + Documentation	Mrinal Thakar	2018EE30921	Resourceful, hard-working
Team Member for Design + Documentation	Khushi Pathak	2018MT60783	Exemplar initiative, innovative, hard-working, regular, an excellent asset to the team
Team Member for Design + Documentation	Aryan Agarwal	2018MT10744	Excellent initiative, regular, hard-working
Team Member for Design + Documentation	Ritvik Ajaria	2018MT10766	Excellent initiative, regular, hard-working
Team Member for Design + Documentation	Kartikeya Badola	2018EE10221	Excellent initiative, innovative, hard-working
Team Member for Design + Documentation	Shaurya Goel	2017MT60784	Regular, hard-working
Team Member for Design + Documentation	Shubh Gupta	2017MT60785	Exemplar initiative, innovative, hard-working, regular, an excellent asset to the team
Team Member for Design + Documentation	Tanishq Gupta	2018EE30567	Resourceful, hard-working

2. Document Identification

ID	v0.0
Team Name	B
Approved By	Shauryasikt Jena (LC) / 30-05-2021 / 1400 Hrs
Contact for Queries	Siddhant Priyam
Certified By	Prof. Subrat Kar, Course Coordinator || ELP305: Design and Systems Laboratory
Date of Certification	2-06-2021

3. Document Statistics

3.1 Text Stats

#sentences	#words	#complex words	% of complex words	Average words per sentences	Average of syllables per word
43	842	359	42.063%	19.58	1.75

3.2 Readability Indices

Flesch-Kincaid Reading Ease	Flesch-Kincaid Grade Level	Gunning Fog Index	SMOG Index	Coleman-Liau Index	Automated Readability Index
39.06	12.68	10.35	13.22	12.96	11.67

[GitHub Repository]

4. Design Of A Mobile Charger

Project 1: To design a household mobile phone charger that is industrially viable

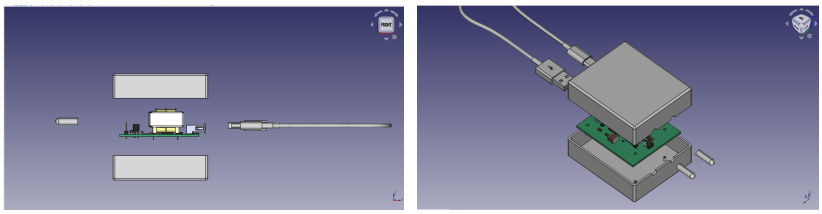

Fig 1: Mobile Charger

4.1 Abstract

Our first experiment was to design a mobile phone charger that produces a regulated DC output voltage of 5V. The whole charger was fit within a standard 1in x 2in x 2in enclosure with 2 round pins to go into the socket and a USB type-C port for appropriately compatible smartphones. The chargers cost INR. 664.19 per unit which is industrially feasible for standards of mass production. The charger was based on the principle of AC-DC rectifier which converts a 220V-50Hz AC supply to a regulated DC voltage of ~5V.

4.2 Summary

The designed mobile phone charger consists of tantalum and multilayer ceramic capacitors; 62nH and 62uH inductors; 6.8 Ohm, 6.8k-Ohm and 1M-Ohm resistors; 1N4148 diode, and an LT3010-5 IC.
The AC-DC rectifier circuit that converts an AC supply to DC output consists of a step-down transformer, a half-wave rectifier and a Voltage-regulator. The step-down transformer converts a high alternating voltage of 220V into low voltage. Then the output is fed to the load in parallel to the shunt capacitor. The capacitor acts as a ripple filter resulting in an approximately smooth DC voltage with minimized ripples across the load. Finally, the voltage regulator produces a regulated DC output of 5V.
We designed the circuit schematic by choosing a load suitably similar to a mobile phone, correct input frequency and voltage. Then we etched the whole design on a Printed Circuit Board (PCB) because of its ease in scalability and building. KiCAD was employed to implement the PCB design. All the components on the PCB were arranged keeping in mind their dimensions, minimal interference, linear flow of the current, minimum weight of the board, and minimized cost of fabrication.
The components of the charger includes plugs, Charger PCB, an adapter case split into lower and upper halves, and Type-C USB cable. The final dimensions of the charger body are 33 mm x 57 mm x 67 mm. The materials used are - ABS plastic/PVC and PTFE(Polytetrafluoroethylene)/FEP(fluorinated ethylene propylene). Finally, we were able to design a 3D PCB model of a mobile phone charger based on an AC-DC rectifier, its schematic and run required simulations to guarantee optimal functionality.

Link to Project GitHub folder

5. Design of Communicating Mule Bots

Project 2: To design Mule Bots for supermarket shopping, that can communicate with each other for increased functionality

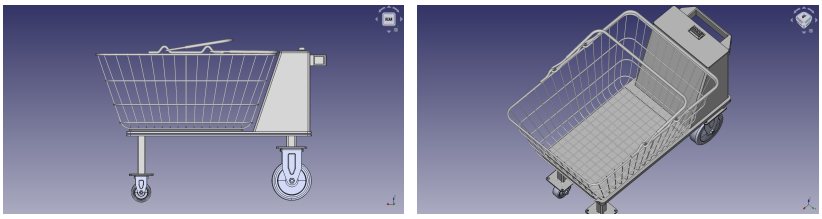

Fig 2: Mule Bot

5.1 Abstract

The next experiment was to design Mule Bots to aid customers to handle shopping load in supermarket stores, with communication modules installed for more efficient functioning utilization of resources. Each individual bot was designed to handle up to 40 kg of load safely, with Bluetooth and GPS incorporated to track its respective customer and a 4-wheel drive for navigation. Moreover, RGB-D sensors were employed to detect and avoid obstacles. A central server was set up with Raspberry Pi Wi-Fi module to maintain communication channels across all the bots in given store.33

5.2 Summary

The primary purposes of the bot are to carry load and follow the assigned customer. For bearing load, a platform was made where pre-existing shopping baskets can be loaded for easier handling during billing and when not in use. This platform was raised by suspension springs to shock-proof the electronics underneath, and also served as the weighing plate.
The weighing plate was above a load cell which fed input to the HX711 weight sensor within the instrument box. The Raspberry Pi 4 microcontroller then processes this and displays load weight on the display atop the instrument box. The instrument box also houses the HC-05 Bluetooth module to pair with the customer's phone and track them with GPS data via the Parallax PAM-7Q High Accuracy GPS module.
For navigation, four cardinal proximity sensors with one frontal RGB-D sensors were employed to detect the surroundings. After realizing the existence of any obstacles, the bot is encoded to follow the Tangential Obstacle Avoidance algorithm to move. The bot is supported by a pair of 4-inch swivel cast wheels in the rear and a pair of 2-inch swivel cast wheels to the front for free 2D movement. An L298 Motor controller module regulated the motors to control wheels via the Raspberry Pi.
The bot is powered by a 12V-20800mAh Rechargeable Li-ion primary battery with a 7.4V-6600mAh Rechargeable Li-ion backup battery. For charging, each bot requires a dedicated 12V Li-ion Battery charging dock. For communication, all the bots are locally connected to a central server by a R-Pi 802.11 n/g/b Wi-Fi Adapter. Data packets are formulated as feature vectors with all the relevant information followed by SHA256 Hashing before being transmitted from bot to server or server to bot. The central server/R-Pi follow through the message packets and implement the required action for increased functionality such as efficient allocation of battery charging times, peer guiding of disconnected bots, replace a bot in distress and more.

Link to Project GitHub folder