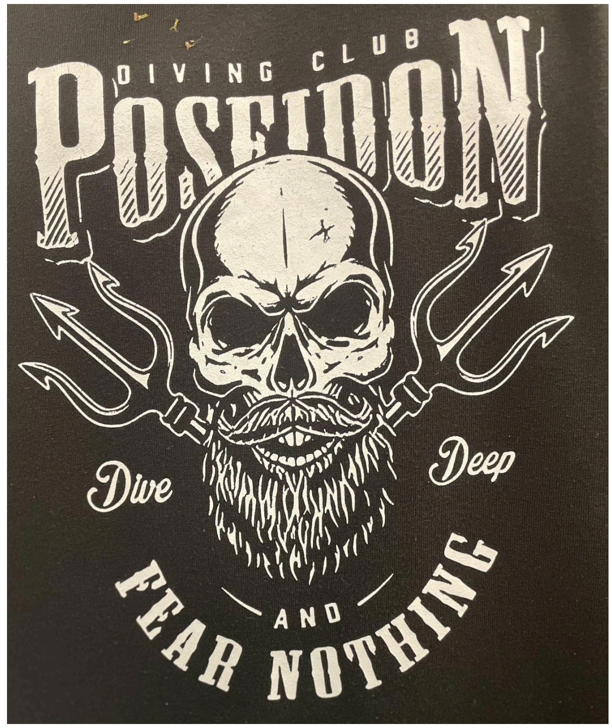
22266 Poseidon
2024 - 2025 Engineering Portfolio



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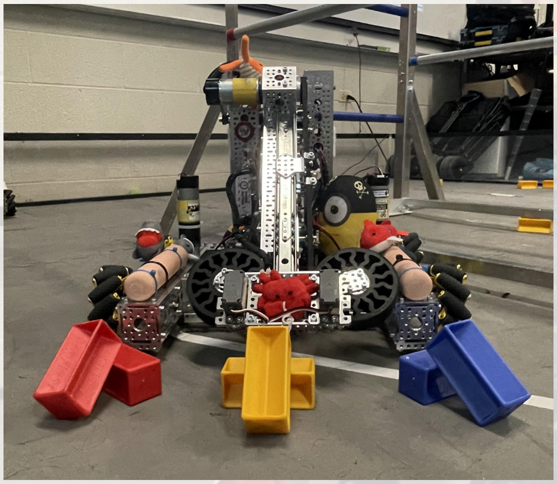

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Team Organizations

Members Name	Duties:
John Del Valle	Captain, Design, Coding, Mentoring, Building, Scouting
Hector Lopez	Co-Captain, Builder, Driver, Coding, Mentoring
Caroline Luna	Driving, Coding, Scouting
Jose Rivera	Strategy, Building, Scouting, Communications
Tutu Bell	Marketing, Webpage, Scouting , Fundraising
Mr G	Mentor, Building, Coding, Fundraising
Kevin Mendoza	CPS roving Mentor

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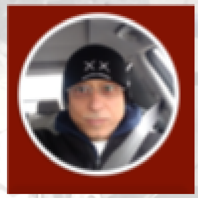
Sponsors

- **John Deere** sponsorship
- **Gene HAAS** Sponsorship
- **Edwin Gerena** Sponsorship/Mentor
- **North Grand High School**



Team Motto

Improvise

Use what is Available

Adapt

Adjusted to new Conditions

Overcome

Succeed

Our plan this year was to build on last year's experiences and then to continue to learn coding and recruit younger team members, continuously improve our knowledge, and pass on what we've learned to new members. We aim to compete fully in the meets while also helping others with less experience in a "**pay it forward**" approach. We want to train all team members in areas of engineering, teamwork, organization, written communication, programming, and public speaking. We're committed to improving our individual skills while also sharing our knowledge with the community to inspire others in STEAM.

Team's Goals for Skill Development: Our goal this season was to learn about encoders and implement them in our codes along with telemetry position update. Our goal next year is to work with IMU and odometry wheels while transitioning from Blocks proficiency in Java for autonomous navigation and sensor integration.

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Technical Skills: **Programming:** Proficiency in object-oriented programming in Java for robot control and sensor integration. Specifically, we aim to learn how to use odomentry wheels , IMUs, and computer vision libraries & (Huskeylens or Limelite).

Mechanical Design & Fabrication: Learn CAD software (Onshape) through online Robotics tutorials and practice exercises. Design and build prototypes of robot mechanisms, iterating based on testing and feedback *throughout the season.* Utilize the mentor classroom and tools, with supervision from mentors *during designated build sessions. By implementing the The **leapfrog** we are looking to **minimize our risks** this method allows us to create one functioning robot with a copycat robot that we try our ideas, builds, revised coding and then have members test it to see if we want to go with that design, revised codes, or any type of modification or try something else out.* One of our members is currently learning Onshape. We want to learn about gear ratios, torque calculations, and different types of drive systems. https://learn.onshape.com/learning-paths/cad-for-robotics

Soft Skills: **Communication:** Hold regular team meetings in the morning and after each session with clear agendas and assigned roles, Practice presentations to the team and mentors. Participated in outreach events to communicate with the community. *Throughout the season.* Implement a team feedback system for continuous improvement *After each match at the competition.* Improve communication by having students present their weekend on a Tuesday so they can feel comfortable with public speaking through presentations, team meetings, and outreach events. We want to be able to clearly explain our design choices and technical challenges.

Teamwork & Collaboration: Foster a collaborative team environment where members can effectively work together, share ideas, and resolve conflicts constructively.

Project Management: Learn basic project management principles, including task delegation, time management, and documentation.

Problem-Solving: Develop problem-solving skills by systematically identifying, analyzing, and addressing technical challenges encountered during the design and build process.

Programming: Attend after school blocks and Java tutorials with the mentor during and after the season.Assign coding mentors within the team to guide newer members. Day 1 of newbies. Practice coding challenges and work on sample projects, *weekly coding sessions using the VRS software and* *on real robots and using a leapfrog method for our design and builds.* Develop and implement a version control system version of code for code management and inserting comment sections.

Team Website/Notebook: In the future publish the team plan on the team's Google-Sites website, create a Google classroom for the robotics team to share resources with each other and possible teams that may need assistance.

Connect with a professional throughout the FTC community via online platforms discord, google meets, Zoom, Microsoft teams, CPS F.T.C. conferences and in person at the events. We scheduled a few video calls to get feedback on our programming or how to resolve a problem. We also emailed goBilda with a discovery on how their original release of their build was incorrect and contacted an **engineering professional named Ethan Doak from goBilda** a few days later they updated the instruction manual. This helped boost our confidence as a team.

In-person: They need to be vetted within CPS before they can be allowed to connect with a professional at the school. However, at conferences and community outreach the rules are different, we are allowed to connect with professionals at these events and have done that..

Outreach & Education: Continue to participate in CPS robotics workshops for younger students in the community to introduce them to STEAM and F.T.C. We allow them to interact with our robots and encourage them to explore their choices. We can also teach some of the basic coding concepts and demonstrate our robot's capabilities.

Virtual outreach: Create online tutorials or videos explaining robotics concepts and programming techniques. These resources can be shared with others and on our team's website.

Events & Field Trips: This year, our team showcased our Robots at the **International Manufacturing & Technology Show (IMTS)**, where attendees such ***engineers, business owners and others from the technology industry*** could engage with the robots and our students. In addition to meeting industry individuals, one of our team members was interviewed for being a female minority on a robotics team. At this event we were able to secure funding from one of the contacts.

Another of our in person connections was when one of our team members participated at the P33. They invited CPS Robotics to have a booth at their **TechRise** event on Thursday, July 25th. TechRise is a Multi-stakeholder initiative that supports historically **underrepresented** technology founders in Chicago and other engineering individuals with National Society of Black Engineers **(NSBE)** and Society of Hispanic Engineers **(SHPE).** One of our students was selected to showcase his summer robotics project at the event, which was a fantastic opportunity. This made it a culminating moment for our team members to present their authentic work in a real-world setting.

We also showcased two of our robots to the **community** during a community high school investigation event, giving prospective students the opportunity to explore our programs and interact with the robotics team. We also presented our robots to the community, providing insight into the challenges and opportunities we've encountered and the fun season.

CPS students came to our open house and we **showcased our FTC robotics team**, such as the **things we were learning** and increasing our confidence in learning this. We also **engaged with younger kids** and informed them that they can do **First Technical Challenge or First Lego League** programs if they offer it at their school no experience is required. .

Attend a local engineering exposition at Wright community college for Juniors/Seniors students with Dr. D. Espirtu or technology shows to learn about different career paths and network with professionals. Attend college fairs inside our school as well as on our own.

Collaboration with Other Teams:

Collaborate with other FTC teams in our region to share ideas, best practices, and resources. We will attend joint build sessions and all the CPS scrimmages This year we collaborated with at least three CPS teams and one non CPS team, providing some help, ideas and parts to help them get going.

Participated in online discord forums and communities to connect with FTC teams in and around our area even with teams in Canada. We share our code ideas and struggles looking for advice along with design ideas and get feedback from other teams.

As a team we feel by implementing these strategies, it helps us to **create a comprehensive team plan** that fosters ***skill development, builds valuable community connections, and sets the stage for a successful season.*** Remember we have to review the game plan as needed throughout the season and off the season..

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During a professional development session on robotics led by our mentor at DePaul University for CPS instructors, our mentor was presenting on Robotics classes, discussing the pros and cons of running a First Technical Challenge team and shared information about the Chicago Public Schools (CPS) Robotics FTC teams and their program.. He was fortunate to have a CPS robotics mentor Kevin Mendoza attend and share the FTC, FLL, & FRC program with educators. They also have some simple robots like the Ozobot, BeeBot, in a lending library for teachers to use. They also announce how CPS is providing robotic training for cluster programs for diverse learners educators to teach them so those students can have access to it.

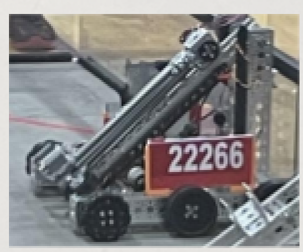
Discovery Partners Institute (DPI) Computer Science Educator Workshop, our mentor was invited to join their fireside chat to showcase the FIRST Tech Challenge robot the students built, along with the coding behind it. During the discussion, our mentor highlighted the challenges we faced as a young team, including team formation, team dynamics, coding and building processes, and managing a small team. The conversation also touched on financial sustainability, learning opportunities, and how we navigate our lack of experience in this environment and how our hard work and determination we were able to qualify for a state tournament last season.

Online webinars or virtual conferences related to robotics, engineering, and computer science. Our mentor is attending sessions later in February on topics like artificial intelligence and machine learning and will share this knowledge with us at the end of February. He will be talking to others on the use of the Limelight camera Barbara Lau who presented this at another event we attended once the season is over.

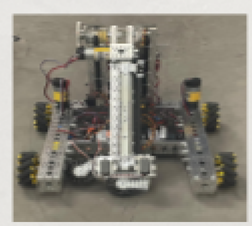
Evolution of our Robots:

Original Design

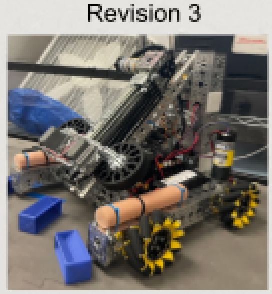
Revision 1



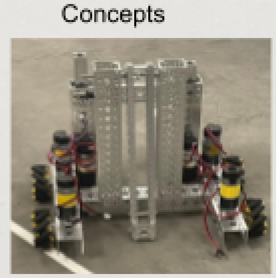
Revision 2



Revision 3



Revision 4 Concepts



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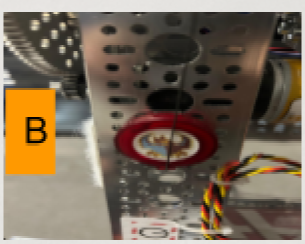
Hardware used beside, screws, nuts, tie wraps, connecting gears, hubs & Shafts

(1) Control Hub	(1) Driver Station	(1) Expansion hub
(4) 312 RPM motors	(1) 117 RPM motor	(1) 223 RPM
(2) Torque servos	(4) Mecanum Grip Wheels	(1) four stage vipe slide
(2) 2lb weights	(2) 15 U Channels	(1) Slim U Channel
(1) 10 U Channel	(2) 11 U Channel	(2) 17 Slim U Channel
(2) Gecko wheels	(1) 100 tooth gear	(1) Pinion gear
(2) Logitech f310 Controllers	Servo extensions connectors	

Wire Management Challenge: *A thought out wiring system prevents interference with other moving parts:*

A. Cable Carrier chain to protect our wiring system.
B. Retractable school ID for bringing wire back and out of harm's way.
C. Flexible tubing to protect motors wiring
D. Cord organizer to protect our servos wiring
E. Plastic grommet to protect our cables inside the U Channels



Programming challenge : This year, we set out to expand our programming skills by incorporating functions, disabling blocks, and adding comment sections. A key focus was using encoders to control motors, ensuring precise positioning within a defined variance. This required us to integrate encoder feedback into our control system, which significantly improved the accuracy and consistency of our robot's movements. We also implemented a display to show the target position of the motors on the drivers hub.

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In addition, we challenged ourselves to implement a two person drive team, programming for two (2) remote controls for our drivers and developed a program to limit the arm's position, which deactivates the viper slide when the arm reaches past a preset destination. Therefore, we did not need any type of sensors to achieve this, we manually determined the encoder values for the arm's range of motion, using both a program and testing to fine-tune the limits. Lastly, we integrated an autonomous drive system to enable the robot to drive automatically while respecting these preset encoder limits.

Autonomous mode: As beginners in block programming, we're learning through our mentor, the VRS simulator, videos, and other teams. We're integrating encoders into eight autonomous modes while refining strategies with our alliances. Currently, we're developing code to pick up specimens and place them in the second chamber. We've doubled our score from 6 to 12 points and now aim for 12 to 18, depending on alliance agreements.

Teleop mode: This year, we challenged ourselves in TeleOp mode by adding comment tags for each section of code and learning to create and call functions. Gaining confidence, we explored encoders-researching, testing, and consulting other teams, CPS mentors, and FTC mentors to deepen our understanding. We learned that encoders start at zero, can have positive or negative values depending on the motor, and should reset to zero after reaching the target position to remain active. We also worked on adding small variances to compensate for battery levels. To further improve, we implemented a two-person drive team system, developing code to support both the main driver and the pit boss.

<u>**LOGITECH F310 CONTROL CONFIGURATION**</u>

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Gamepad 2
Pit Boss

- **B** = Closes gripper
- **A** = Open gripper
- **Y** = Fishes in the pit
- **X** = 1st level specimen hang

Back = Available

Up = gets you out of the pit
Down = future ideas
Right = future ideas
Left = future ideas

used for fishing things out of the submersible CODE DISABLED

Version 3

Ver 1	Squidwards: tank drive, arm, two state viper slide, hang, viperslide Open and close gripper, basket grab 1 & 2
Ver 2	Shrimp: 2 stage viper slide with encoders, Mecanum wheels code, 4 autonomous with encoder, programming limit on arm and closing gripper, basket 1 & 2, wall grab and 2nd chamber hang
Ver 3	BigWheels: 4 stage mini viper encoder codes positions and telemetry update to see on the screen,, Mecanum wheels code, 8 autonomous with encoder, programming limit on arm and closing gripper, basket 1 & 2, wall grab and 2nd chamber hang, submersible grabs, also a code call fishing but inactive due to drivers feedback

Feedback from Drivers: Feedback from our drivers! On the control and the robot's performance is crucial for making improvements and modifications..

Control Feedback: Switching from one controller to two can change the dynamics of the robot's operation and improve team communication. We had to adjust the robot's so that it can perform tasks without the need for complex coordination between two operators.

Simplicity vs. Functionality: Our goal was to divide the task for the two drivers so that they are not overwhelmed by multiple controls. Simplifying the design of the robot's actions by creating more intuitive control schemes made a big difference. We programmed some tasks to be automated further to reduce manual intervention?

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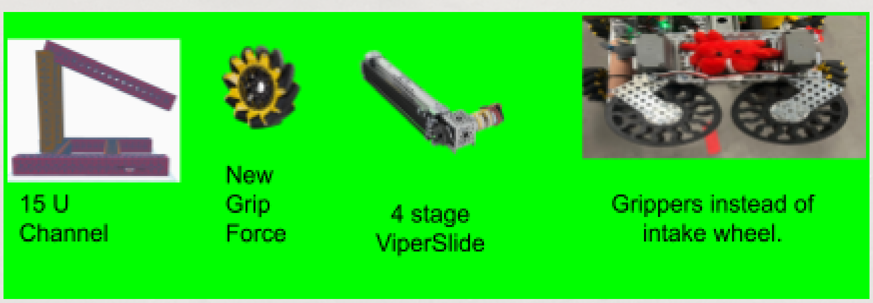
Autonomous and Manual Switching: This approach allowed for seamless transitions between autonomous and manual control that was useful. The robot could perform routine tasks autonomously, but then the drivers would take over for more complex or delicate maneuvers when it was time.

Our Solution to this year's Gaming challenge: During testing, we found that the robot was prone to tipping when attempting a hang, so we **added weights AKA (torpedos)** to the robot's frame to prevent this. Since we hadn't fully determined the center of gravity, the additional weight helped stabilize it during those crucial moments. To make the robot stand out and add some fun, we added a personal touch with a few stuffed animals-a Minion, a turtle, a shark, and a shrimp-because we wanted to keep things lighthearted while still focusing on performance.

Engineering Process: After carefully evaluating the GoBilda StarterBot and starting our build, we *noticed that* ***the provided instructions were inaccurate. We reached out to Ethan Doak from GoBilda via email, and a few days later, they updated the build instructions on their website.*** We incorporated their revised design but made **modifications** for our first robot, including adding a two stage ViperSlide. We didn't like the intake feeder they provided, so we opted to use a gripper from our previous season instead. Rather than using the provided code, we decided to develop our own. Our goal was to use the StarterBot as a foundation and build upon it once we gained real-world experience, experimenting with different variations to find what best fits our current skill set. Our team currently lacks CAD skills, so we rely on hand-drawn sketches, images or laying out parts on the floor to create mock-ups. However, we failed to document all of that process. The good news is that one of our teammates is currently learning OnShape in her Engineering class, which will allow us to develop a more robust engineering portfolio.



<u>**Encoder formula used:**</u>

Current formula is:

$$\text{Ticks} = \frac{\left(\frac{B}{C * D}\right)}{E} * F$$

Cleaned up Formula is:

$$\text{Ticks} = \left(\frac{B * F}{C * D * E}\right)$$

Encoders by inches

Let Variable	Be	Value		
A	Distance to Travel (in)	20	<--	This number needs to be typed in by user
B	Distance to Travel (mm)	508		
C	Wheel Diameter	104	<--	This number needs to be typed in by user from wheel manufacture
D	Pi	3.141592654		
E	Gearing Ratio	19.20320856	<--	This number needs to be typed in by the user from motor manufac
F	Ticks per Rev	537.7		

By utilizing basic Algebra it can help you calculate the encoder values you need to control your robot's movement more precisely. This can be done for Centimeters or Inches.

Some Solutions we opted for: Accuracy & Precision

Tried A Coding Solution: Without encoders, we had to rely on timing-based movement, which led to inconsistent results due to variations in battery voltage and friction. ***Sensors:*** Encoders provide precise distance measurements, ensuring consistent movement.

Tried a sensor for the viper arm slide and metal beam.

- **Using Sensors:** A touch sensor helped detect a limit and stop movement automatically with the bar but it did not allow us to go for a hang.
- **Coding Solution:** Without a sensor, we were able to use encoders to get to a desired stopping point and inactivate our viperslide along with closing the claw.

Lesson learned: There are many ways to approach a problem, but identifying the solution that best fits our specific needs and goals is crucial. While we discovered other ideas and concepts that worked, they didn't always align perfectly with our application, reinforcing the importance of selecting the right approach.

As we embraced **this season's challenges**, we had to **identify our team goals** and set deadlines. Our key focus areas included:

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Climbing & Hanging This was a core task, and we initially used a GoBilda design. However, due to the 42" height limit rule, we had to disable our hanging mechanism for the first event rather than modifying the code. To ensure reliability, we programmed arm limits and deactivated our ViperSlide at a specific position.

Scoring Points in Baskets Precision in movement is crucial, especially in TeleOp mode. We calculated encoder values for both the arm and ViperSlides to ensure accuracy when targeting scoring positions.

Specimen Placement on Higher Rungs Consistency was key. We accounted for battery level variations to ensure our code performed reliably-from grabbing the specimen off the wall to retracting and placing it in the correct scoring position.

Submersible Area Interaction: We tested two programs. The first, was called "Fishing," allowed manual control over the ViperSlide and arm for flexible positioning, but the drive team preferred a preset position approach. We adjusted accordingly to our drivers feedback and the robot successfully retrieved items during practice and gameplay.

Collaboration with Another Team

Working with another team, especially in autonomous mode, added complexity. We had to consider multiple strategies to optimize performance for both robots. In TeleOp, coordination was critical-especially when an alliance partner attempted to hang. At times, we synchronized well, but other moments proved challenging as we worked to align our actions effectively.

This season reinforced the importance of adaptability, precision, and teamwork in our approach.

As a team, our challenge for next year is to implement key improvements, including learning how to use odometry wheels and the IMU unit inside the Control Hub, OnShape CAD skills, HuskyLens, and acquiring a Limelight camera.. We aim to recruit a team of at least eight members, with roles divided into a competition team and a support team. The support team will handle tasks such as research and development, webpage maintenance, and fundraising. Additionally, we'll have a practice team to create and manage our Red versus Blue teams for competition preparation.

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Fundraising:

This is a tricky beast to maneuver within Chicago Public school (CPS), any and all fundraising must be approved by the Local School council. Then the money must be submitted to CPS and it has to be cleared in order for us to use it. Once it clears we are only allowed to purchase materials from approved CPS vendors. Unfortunately for us GoBilda is not an approved vendor and they are not interested in becoming an approved vendor we tried and they started the application process and stopped it. We reached out to them and they decided it was not worth the hassle. We have to be creative in order to get our equipment and must consider perhaps going with their approved vendor or not to continue this endeavor.

The following amounts were collected this season as a form of fundraising/grants and our mentor creative donation method: $ 7,100.00:

Name of Person/Organization	Amount
Edwin Gerena	$ 4,108.00
John Deere*	$ 900.00
Gene HAAS**	$ 2,000.00
North Grand High School ***	$ 2,000.00

Expenses: This season these are the expenses we incurred in acquiring some of our building materials and working toward our future goals. Please note that these items were purchased between September 2024 and December 2024. In **September, we focused on securing materials** for our **field and control systems. In October**, we made the **largest portion of our purchases,** which included design builds and field components from Andymark, as well as ***implementing the leapfrog method*** previously mentioned. By ***December, the remaining funds were used to donate a complete field to CPS FTC North Side***, which will serve as a traveling field for CPS.

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Also, please note that the expenses outlined below ***does not include costs for tournament transportation, food, additional tools, 3D printers spools, team swag, snacks and a color printer,*** or any other necessary items we feel as a team that is important to us, even paying for a pair of prescription glasses for one of our team members. This is a recap of our expenses : By **making these investments now** our goal will be to **minimize our future expenses** and continue to create a sustainable **system within our means** and thus ***eliminating the mentor's financial contributions***.

Total Expenses this Season as of January 2025 is $ 9,008.00

Name	Amount
Registration Fee/Control and Communication/Field tiles	$ 912.00
GoBilda Channels, gears, motors, camera, Gripper wheels, intake wheels, etc. HuskeyLens,	$ 2,916.00
2 Control Hub power system, 2 Expansion hub, Driver stations	$ 2,800.00
Andy Mark	$ 2,380.00