



POWERED BY



## 2021 Team Innovations

**FIRST<sup>®</sup> LEGO<sup>®</sup> League**  
**FIRST<sup>®</sup> Tech Challenge**  
**FIRST<sup>®</sup> Robotics Competition**

## FIRST® LEGO® League Innovation Project 20 Finalists



40745 - Believe and Achieve Bots, USA  
Correction Coach

**Believe and Achieve Bots** started out in *FIRST* LEGO League Explore, and is now in their third year as a *FIRST* LEGO League Challenge team. They love STEM activities and have enjoyed the learning experiences and teamwork throughout their journey. Their team is constructed upon a couple of different pillars, such as respecting each other, having fun, and including everyone. They support people on the autism spectrum and those who are less fortunate than others, with an additional goal this year of helping people be more active.

The **Correction Coach** is a wearable, instant feedback device that helps individuals improve their sports/activities by helping users to train and improve limb movements to learn sports and activities correctly. It achieves this by using a non-contact ultrasonic sensor and providing real-time feedback via light and a Bluetooth connected smartphone app with data acquisition. This can be used by users who want to learn activities and hobbies in the right way, develop muscle memory, and enhance their existing skills.

Blazing Stars, USA  
UltraBlaze



**Blazing Stars** as a team was formed in 2017 with

four team members and one youth mentor. They chose the name Blazing Stars because it represents each member: vibrant, bright, alive, and unique. Since 2017, new team members have joined, bringing in new ideas and creativity to the table. As a team, they've learned skills from each other, such as leadership skills, programming skills, mechanical skills, social skills, empathy, and more! But most importantly, as a team, together they learned the value of friendship.

**UltraBlaze**, a low cost training skateboard equipped with object detection and warning system, provides an opportunity to visually impaired children in the age group of 8-12 years to explore the world of skateboarding with renewed confidence. The team was inspired to create this solution after learning through an interview with professional visually impaired skateboarder that "going in a straight line is probably the toughest thing to do without his vision", and they decided to tackle the factors that could lead to the above problem, such as holding a cane, which could result in imbalance or a feeling of dependence, or the mental block or fear of hitting an object.



### **The Blue Jay Bots, USA** **The Mobile U Walker**

The **Blue Jay Bots** are celebrating their fourth year as a *FIRST* LEGO League team. The current team consists of a group of seven great friends that meet in-person in Austin, Texas with one remote member in Portland, Oregon. As a team, they focus on Core Values, and host a yearly fundraiser, multiple information gatherings, and scrimmages to benefit their local community and to educate others about *FIRST* LEGO League.

When walkers are difficult to use, the elderly and injured can become less active, which degrades their physical and mental health. **The Mobile U Walker** combats this problem by raising and lowering its legs so that users can comfortably stand up from a chair and walk. An attached light shines signals on the floor to cue the user where to stand or walk. Because it has 2 legs instead of four, the Mobile U Walker is compact, also allowing users to more easily navigate areas.

### **Climb Blind, Norway** **Climb Blind #Grips for visually impaired climbers**

**Climb Blind** is a *FIRST* LEGO League Team from Norway that participates in *FIRST* Scandinavia.

Blind and visually impaired climbers are today dependent on a helper standing at the bottom of the wall. The helper guides the climber along the route. A problem with this is that the climber have to wait a brief moment between the messages from the helper, and the climber must usually search for each grip for a brief second. What if blind and visually impaired climbers had a way of finding the next climbing grip faster? What if they could train and climb more independantly? Could they climb faster and even climb harder routes? We think so!



### **The Corti-Patch Kids, Canada** **The Corti-Monitor System**

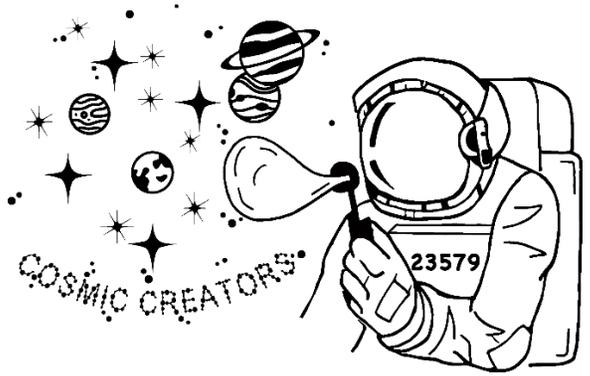


The **Corti-Patch Kids** consists of 9 students, ages ranging from 12-15, who are mostly new to the *FIRST* LEGO League. Though they mostly stay on task during meetings, they like to occasionally take breaks and indulge in fun team-building games. The team members appreciate each other as teammates and are all extremely eager to be a part of this fantastic journey as a team.

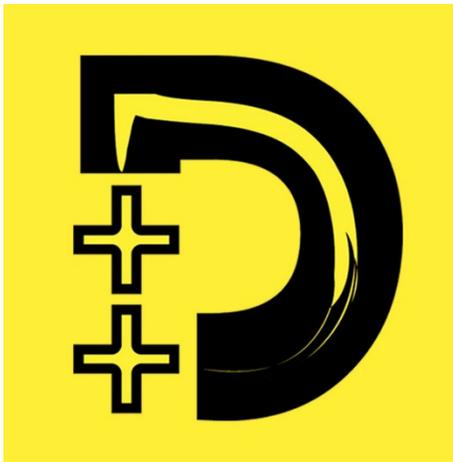
People with Addison's disease aren't able to produce enough steroid hormones. They experience a wide range of symptoms but most importantly if their cortisol levels get too low, they may encounter an Addisonian Crisis. The **Corti-Monitor System** provides Addisonian patients with live up to minute knowledge of their cortisol levels so that they are able work out/exercise without concern. The Corti-Band combined with the Corti-Patch Pod is able to monitor and send immediate instructions to the pod, which administers a hands free injection of hydrocortisol, when required.

## Cosmic Creators, USA Improving Baseball for the Blind and Visually Impaired

The **Cosmic Creators** are the five year team out of Des Moines, Iowa. They started with ten members representing six different schools in the Des Moines area. This year's team is made up of five 9th graders who have been with the team since the beginning. They love *FIRST* LEGO League, but their favorite part is the excuse it provides to hang out regularly with good friends.



In their research, the team learned of a sport called Beep Baseball (or Beepball), a version of baseball for the blind and visually impaired, that relies on beeping sounds to guide players to bases. The team decided to use white noise in place of beeps to improve some problems with Beepball. White noise is more locatable through background noise, easier for people to pinpoint a location, and is even easier for people who are losing their hearing to locate.



### D++, Israel TechKneeCare

**D++** started in 2009 and has won many awards, has competed at The World Festival, and was even Runner-Up at the 2018 FLL Global Innovation Award! This season, the team was proud to have 2018 Team D++ alumni help Mentor them this season. They chose to focus on the difficulty of returning to exercise after a knee injury after one of their team members suffered a knee injury, and had a long and tedious recovery process.

**TechKneeCare** is a knee-physiotherapy home kit that consists of a Bluetooth camera and a customizable application based on the progress of the rehabilitation process. TechKneeCare is innovative because it motivates patients do their physical therapy, helps the patients correct themselves using a real-time error correction software, and implements a game in the home-workout, making the physical therapy fun and exciting!

### Dgital #1331, Israel DO-MORE (Desk & Office – Mobile Ongoing Rewarding Exercise)

**Dgital** is a team in Tel Aviv, Israel. Over the past year, they have strengthened their bonds and made amazing friends with teammates from school teams that participate in *FIRST* Programs. It's very important to to the team that each team member voices are heard and that they recognize each team member's unique abilities, offering everyone an important role in the team. They believe that by continuing working together, they can come up and develop many more amazing products that can change the course of humanity!



The goal of the **DO-MORE (Desk & Office – Mobile Ongoing Rewarding Exercise)** is to provide a product that will encourage sedentary employees to be active, healthy and happy. It is a company social sports-kit and app. DO-MORE's app connects to an IoT pedal device and rewards sedentary employees that exercise while competing with their co-workers in the office or at home. Unlike any other smart pedals in the market, DO-MORE is focused on increasing the motivation of its users to exercise.



### **Goalvolution, Spain** **Positioning Bracelets for Goalball Players**

**Goalvolution** is a *FIRST* LEGO League team that participates from Biscay, Spain.

Inclusion in the world of sports has undergone radical change in the last few decades, but there is still a great number of issues that might discourage people with disabilities from doing sport. Goalball is the only Paralympic sport created specifically for visually impaired people and is based mainly on the auditory sense since it is crucial to detect the trajectory of the ball (with bells inside). Our team has created a movement detecting program using Python to calculate the time accurately and make movement tracking easier. Each player wears a bracelet that vibrates when they arrive at their position.

### **JRA Tunisia, Tunisia** **RUNNER'S SIGHT**

**JRA Tunisia** is made up of kids aged 13-15 who are really passionate about robotics and artificial intelligence. Unfortunately, Tunisian teenagers are persuaded by the prejudices that accompanies technology, due to how tough and how long it takes to learn it, so that's the team is really determinate to change this attitude and to prove that every single child can understand these disciplines and they can work hard and aim high to be the innovators that the world will need in the coming decades.



The team's goal is to let blind people be capable of doing sport in security and give them more confidence while running without the help of another person. **Runner's Sight** was created as an autonomous robot that helps blind people running by guiding them on an Olympic race track. The principle of operation is that the robot will follow the rhythm of the blind person's race, indicating the direction in a complete safe way.



### **Lego Legion, USA** **SmartSteps System**

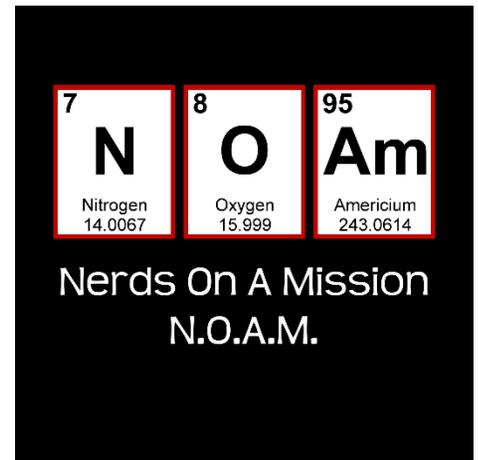
**Lego Legion** is a 9-year, homeschool team from Cincinnati, Ohio. The team currently consists of the younger siblings of the original team members. Their motorized chicken mascot named Octavius went to the *FIRST* Championship and has been featured in *FIRST* promo videos! The team participates in many outreach events, and loves to spend time together as team but also as friends. In addition to working hard as a team, they play laser tag, host movie nights, spend time together in class at their co-op, and even celebrated their season with a trip to an indoor waterpark.

Patients recovering from lower-extremity injuries or surgery can put too much or not enough weight on the recovering limb, hindering recovery and risking reinjury... keeping them from being active! The **SmartSteps** System is a shoe insole equipped with sensors measuring weight put through the foot. The insole is paired with an app for device setting and patient-therapist communication and monitoring. Continual weight-bearing

monitoring gives patients the confidence to be more active during their recovery while lessening the chance of reinjury.

### **N.O.A.M. Nerds On A Mission, USA** **The Winter Warmer**

**Team N.O.A.M. - Nerds On A Mission** is a community team made up of 7 team members, three rookie members and four veteran members, from the Holmen, Wisconsin area. The team also enjoys mentoring a *FIRST* LEGO League Explore team, The Mini Nerds. Their official team mascot is FLL Cow, and each year, the team makes sure the cow has access to the Mission Models on the *FIRST* LEGO League table. It all started one season when they launched their LEGO cow, Luna, over the Crater Crossing (*FIRST* LEGO League Mission Model) so she could achieve her dream of jumping over the moon.



**The Winter Warmer**, a garment you wear under your coat that helps keep you warmer longer, was created to help keep people active during the winter in colder climates. Pockets on the inside of the garment hold reheatable corn bags. Simply heat the corn bags in the microwave, and it will supply you with warmth while you enjoy more active time in the cold. The Winter Warmer utilizes space blanket fabric on the outside to radiate heat back to the wearer and has a washable, moisture wicking interior fleece layer to protect the wearer from the hot corn bags.

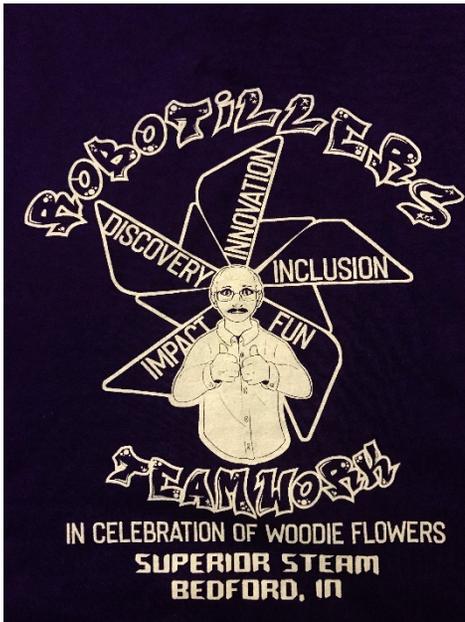
### **#PandaPower, USA** **PlayAR**



Brought to you by:  PandaPower

**#PandaPower** is a team of three girls with varying *FIRST* LEGO League experience. They focus on learning throughout the year and making sure that each team member not only always feels included, but also like they are growing from being a part of #PandaPower. This year, the team members have bond over silly things like pandas and video games and their more serious desire to help the world and have a measurable impact.

The **PlayAR** is a a library of augmented reality fitness games with a goal of increasing activity by making movement more fun. The library contains FlappyBird, Pong, and BrickBreaker, which use your camera on your computer/phone to use your face as a controller and mix fitness with games. Users can score in the game by doing push-ups and squats. The game is currently published with an active leaderboard!



## Robotillers, USA Limestoneopoly

The **Robotillers** are part of a larger 4H youth development program called Superior STEAM, whose main focus is to better the community. Each year, the team participates in at least 30 core value activities, including the GM Get Wise Women In Engineering Event, creating innovative engineering and robotics devices to deliver candy safely from six feet away during Halloween, and local STEAM nights around schools and churches.

When interviewing their community, the team learned that those in their community wanted fun, engaging, and challenging activities to do with friends and family. **Limestoneopoly** is an interactive game that not only motivates players to get out and be active, but also inspires them to be more involved with their town square or wherever the game takes place. Users can play this game anywhere with friends and family as long as they have the app and the QR codes necessary.

## SESI Biotech, Brazil Move Bag

SESI Biotech participates in the *FIRST* LEGO League from São Paulo, Brazil.

Sedentary lifestyle is one of the greatest problems in the world.

**Move Bag** is a multifunctional and sustainable backpack to practice physical exercises, and is attached with an elastic system put in strategic places that allows us to do several types of exercises working with all muscle groups. One of the biggest complaints around exercising is a lack of time to practice physical exercises, and with our solution, they will have the ease and practicality of exercising in any place, such as the bus stop while waiting, a bank line, while going to work, or at home.



## SESI Big Bang, Brazil FIGLOVE



The **Big Bang Team**, from SESI-SP School of Birigui Town, from Brazil is composed by 8 members: 2 programmers, 2 builders, 2 researchers, 1 mentor and 1 Coach. Each member of the team has a role sharing knowledge throughout Delta's function method and encouraging teamwork. They love to be part of this *FIRST* LEGO League and their goal is to make the world a better place, helping our society throughout solving the daily problems with scientific and innovative projects.

Fibromyalgia affects 22 million of Brazilians and more than 350 million people around the World. **FIGLOVE**, an innovative strip placed in the palm of the hand that reduces the pain during the practice of exercise, helps to make people with fibromyalgia active for longer periods, which helps to reduce their symptoms. The solution has a system with LEDs and Piezo Ceramics wafer, generating pulsed vibrations that

works during the practice of exercise, reducing the pain caused by the syndrome, because it produces an analgesic and anti-inflammatory natural effect.

### **Shakespearean Pirates, USA** **ExerWheel4000**

This team is called the **Shakespearean Pirates** because they wanted to talk in funny accents and play with swords during our presentations. The team members live near Phoenix, AZ, and are two pairs of homeschooled siblings and all great friends. One pair has 3 & 4 years of experience and the others are participating for the first time this year.

The **ExerWheel4000** is a simple add-on for existing wheelchairs that converts exercise movements into wheelchair motion, providing wheelchair users with more opportunity to be active. This simple, but innovative exercise system easily attaches to the wheels of most manual wheelchairs. It features an adjustable bar and double ratchet system that allows for seven different exercises. These additions allow users to achieve the benefits of physical activity including reducing their risk of type 2 diabetes, cancer, heart disease, and obesity. Emotional benefits include lower stress and anxiety, better sleep, and an improved mood. Cognitive benefits include improved memory, lower risk of dementia, and increased focus & concentration.



### **Taggin' Dragons, USA** **Acti-Vest**

**Taggin' Dragons** is a team of 5 students from 4 different schools in Salt Lake City, Utah ranging from 6th to 9th grade. This is their second year together as a *FIRST* LEGO League Team. For fun, they have gone hiking, fishing, bowling, and glass blowing, but their fondest memory is a friendly game of archery which they are happy to report resulted in zero casualties! Their next planned adventure to celebrate this

year's achievements and in keeping with this year's theme of staying active, is to go camping and paddle boarding together!

Taggin' Dragons developed the **Acti-Vest** with the mission to empower the visually impaired to navigate and explore the world around them. It is an affordable and discreet solution that enables the wearer to navigate their surroundings by using ultrasonic sensors to provide the wearer with information about obstacles and approaching objects or people. This year, a moment of validation for our team came when a girl who was born blind used the Acti-Vest to go skiing at Snowbird Ski Resort! This confirmed how Acti-Vest can dramatically impact the lives of people with visual impairments.

**8404 Team Not Found, Canada**  
**Acti-Go All Terrain Sled**

**8404 Team Not Found** is a family and friends team with team team members. Though most of their recent meetings have been online, the team still manages to have a lot of fun together, by playing online games and going to test our project in the park (with masks, socially distanced and when it is safe to do so)! They love to spread the message of *FIRST* by doing outreach events in in their community, regularly bringing their LEGO table and robot supplies to community events, our local museum, and other qualifying tournaments, so that kids can learn to build and program.

The **Acti-Go All Terrain Sled**, which can be used regardless of the weather or season, helps to keep kids active during the winter. Their unique design combines two sleds into one, for use on both grass and snow. The main base has a seat to sit on, with tracks underneath to slide in different inserts for use on different terrains. The current solution has skis for snow and larger rollers for use on grass, but the base can accommodate other kinds of inserts to allow kids who live in climates without snow enjoy sledding!



**Thundercats, USA**  
**The Third Eye**

**Thundercats** is a group of 10 middle schoolers in their rookie year with the *FIRST* LEGO League. The team is proud to have overcome the obstacles presented to them this season while learning the ropes and getting to know each other virtually by focusing on teamwork first, with an emphasis on the *FIRST* Core Values. Through the process, the team learned a lot about how to work best as a team and didn't hesitate to tackle a problem children with impaired vision face when approached for help by an aide in their district.

This Many children with impaired vision miss out on the benefits of outdoor play, due to an inability to identify obstacles while outside. **The Third Eye** is a sensor strap that alerts users of surrounding obstacles. This solution includes an elastic strap with an infrared sensor connected to a haptic motor. If a child encounters a sudden obstruction, the haptic motor vibrates relative to the distance of the obstruction. The Third Eye supplements the white cane, a common assistive device used by the visually impaired. The combination of the two allows the user to identify obstacles at all elevations.

**FIRST® Tech Challenge**  
**FIRST® Innovation Challenge presented by Qualcomm**  
**20 Finalists**



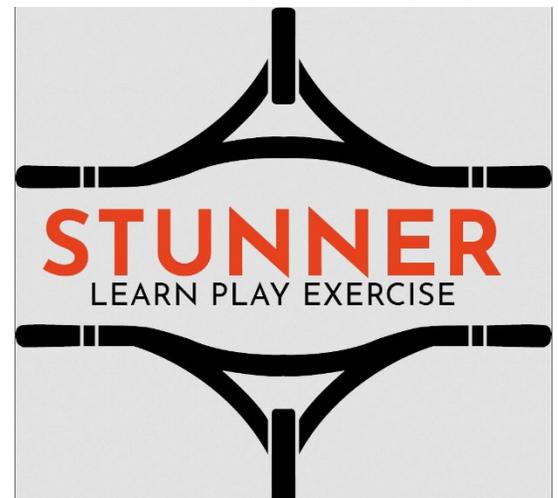
**18368 - ALIEN, USA**  
**Winter Wheels**

**Team ALIEN (Ambitious Leftovers Intentionally Evolving into Nerds)** is a true rookie team, with none of the team members, four freshmen, one sophomore, and one junior from Greendale High School, and two coaches, having any previous *FIRST* experience. Before being part of ALIEN, team members did not know each other and had even attended three different schools the year before. Their journey this season has been one of discovery and teamwork, and they are grateful for the opportunity, proud of the work they have done, and amazed by the goals they accomplished.

**Winter Wheels** is a set of clip-on, traction-enhancing wheel covers for wheelchairs. Easily attachable or removable even while using the wheelchair itself, Winter Wheels allow wheelchair users to maintain traction and mobility in snowy and icy outdoor conditions that would otherwise be unnavigable. The wheel covers can be used on motorized or manually powered wheelchairs, are less expensive than purchasing additional wheels, and do not require any tools for installation. They can also be added and removed when entering or leaving a location to avoid bringing snow, mud, and dirt indoors. Because they can be attached or removed in less than a minute, the choice of whether to use them can be made based on weather conditions at any given time.

**18025 - BSRC Mad About Robots, India**  
**STUNNER | Learn, Play, Exercise**

Team **BSRC-Mad-About-Robots** is a group of young STEM-enthusiasts from Pune, India, comprised of students from grades 6-10, & are best described as being passionately curious; forever asking 'how', 'why', & always ending with 'how can we make it better!' Being enthusiastic about STEM isn't enough for them, and they aim to combine that with passion, drive & determination to spread STEM awareness to the remotest-corners of our lovely country. As they say, alone we do so little, together we can do so much. The team is as diverse as the country they represent. We all speak different languages, have varied-traditions & cultures, but are united in our passion for STEM.



After a classmate was hospitalized due to a mental-breakdown caused by academic pressure balancing between SAT scores, APs and college essays, the team was encouraged to create **STUNNER**, a 3-in-1 solution (LEARN-PLAY-EXERCISE) to such problems. STUNNER is an accessory mounted on the handlebars of your existing exercise-bike. Comprising a game-controller & sensor-unit, STUNNER provides learning in the form of questions while you play video-games & exercising as you cycle. With a custom-designed game, Research Racer, that users can play as they pedal the bike and control using the game-controller, STUNNER captures real-time health-data like heart-rate that can be viewed in the STUNNER app. A coopertition leaderboard shows a mash-up of calories-burnt, game-high-scores, correct-answers & coopertition-bonus along with social-interaction with other users around the world to help make students smarter, healthier and happier!



**6547 - Cobalt Colts, USA**  
**Wii Fit Balance Board for Nintendo Switch**

The Cobalt Colts participate in the *FIRST* Tech Challenge in Kansas.

**Wii Fit Balance Board** allows the user to play video games just like a controller, but with physical movements, combining gaming with physical exercise. It has 4 weight sensors which we use to detect inputs, allowing the physical movements of the player to

transfer to the game. The team has currently created a fully functioning prototype that has been tested on real teen gamers. This concept could be applied to any Nintendo Switch game, giving a broad way to interest a huge gaming community.

**11248 - Cougars, USA**  
**Enabling Long-Term Patient Health Trend Tracking**

**Team 11248** started as a blend of rookies and veterans, yielding a good mix of pre-existing team chemistry with the introduction of new ideas. The team quickly learned how to integrate new members and create a cohesive team. Despite many COVID-19 related obstacles this season, the team was able to collaborate and come up with an idea and an effective solution that they believe will create positive change in these unprecedented times.



When exploring the existing remote health care options available, the team observed a lack of virtual platforms that came close to recreating the environment and evaluation options that are present in a doctor's office. **Enabling Long-Term Patient Health Trend Tracking** seeks to bridge the gap between virtual and physical health through an app that would give doctors and healthcare professionals the ability to evaluate patients through activities, tests, and games to monitor long term health and prescribe necessary treatment. The results of each activity would be quantified, allowing healthcare professionals to measure individual health trends for each of their patients.

**16457 - Deviation, USA**  
**Flex-Fit**



The **Flex-Fit** team consists of three members with varied interests including many participating and watching many sports, math competitions, music, art, and spending time with pets. These three students were passionate about stem and wanted to use it to make a difference in their community. While brainstorming different ideas, one member remembered that when she broke her arm years ago, she often skipped her at-home physical therapy exercises because she wasn't motivated. Team agreed that there should be something to solve this problem, and the Flex-Fit was born.

Many people struggle to complete their physical therapy, occupational therapy, stroke recovery, or just general exercise regimen because of a lack of motivation. We created the Flex-Fit to help combat this issue. **The Flex-Fit** is a Bluetooth device that is controlled by muscle contractions. The device can connect to computers and allows people to play video games by contracting a specific muscle which helps to strengthen it over time and can measure the intensity of muscle contractions, which allows users to see their improvement in strength as

they continue to use the device. Also, the device can allow users to operate computers with just partial control of a few muscles. This will allow users with mobility and dexterity limitations to use computers potentially for the first time.

**16548 - Dream Machines, USA**  
**Fast Find**

**Dream Machines**, team 16548, is a co-ed team from Austin, TX, in their second year of the *FRIST* Tech Challenge program with three veteran members and four rookie members. The team has learned a lot throughout their journey with *FIRST* and continue to learn how to build robots, program them, participate and strategize our meets and build on our Core Values. The team is happy to continue to learn about the innovation process, draft a pitch, seek funds, plan a business, and conduct community outreach activities. They greatly enjoy presenting solutions to professionals and community/leaders and are interested in technical, management, and or business skills development and careers. When not building bots or coding, team members have a hearty laugh with our silly talks and take a walk on the trail.



Dream Machines innovated **FastFind**, a mobile game that allows users to play solo or with a group, will make children and adults, able and disabled, move outdoors or indoors, play a fun game, learn new fun facts, and get rewarded. The FastFind is an easily installed app that leads users on a scavenger hunt walking, jogging, running, biking, or on a wheelchair. Users can simply hit the Play button, choose a trivia subject/level, get a clue for the first location, and start moving. The game assigns points based on the number of calories burned and trivia questions answered as the user progresses through the scavenger hunt. App features include in-app Google Maps for directions, reminders on low or inactivity, text to speech, custom color palette, and connectivity with FastFind smart tags installed in Accessible communities/parks for players in a wheelchair.



**14564 - Fast and Curious, USA**  
**MATRx - A motivating exercise mat for the future**

Team **Fast and Curious**, 14564, from San Diego, California, is made up of 10 members, ranging from grades 7-11, all with varying levels(0-3 years) of experience. All team members have knowledge about all areas of the team, but specialize in what they are interested in. 10 difference languages are spoken across all members of the team! The team's goal is to learn from mistakes, experience, and have fun throughout the season!

**MATRx** is a fun, affordable, configurable, smart mat that guides and motivates movement.

This smart mat takes up almost no space in the home and has the potential to incorporate movement and fun into any sedentary activity (video games, board games, watching tv etc.) that eats into exercise time. The lights in MATRx will guide the exercise, with sensors that help keep the user accountable and measure progress. The configurable squares will allow the user to incorporate a variety of flexibility, cardio and strength exercises, and a variety of games and everyday activities.

**10161 - Fayetteville Free Library SUITS, USA**  
**ExerStep**



Team 10161, the **SUITS**, from Fayetteville, New York has participated in *FIRST* Tech

Challenge since 2015, but but faced many setbacks this season due to the Pandemic. However, the team was able to held together, learning to meet remotely as they searched for funding and recruited new coaches. The team is proud of their ingenuity in finding new ways of doing almost everything this season and is looking forward to resuming in-person meetings in the future, where they believe their toolkit of new ideas and skills will make them stronger and even more equipped to serve and inspire.

Postoperative lower limb joint replacement patients have a heightened risk of dangerous internal blood clots forming within their veins (DVT) due to a lack of lower limb movement.

**The ExerStep** is a compressible foot pedal that encourages and tracks lower limb movement. Its low impact nature makes exercise mild enough for postoperative patients while helping to prevent DVT. Its included analytics software detects use and reminds the patients to exercise according to a therapist assigned schedule. The ExerStep can unobtrusively be used in an office environment while sitting, helping patients to return to work sooner. This, combined with its low cost, makes the ExerStep an effective option for preventing postoperative DVT.



**16944 - FM493RS, USA**

**Scolioxercise: Resistive Exercise Vest with Medical Safeguards for Counteracting the Debilitating Effects of Scoliosis**

**The FM493rs** is a group of 8th and 9th graders who all have a strong passion for science and robotics. Orginiially participating in the *FIRST* LEGO League, their team members have been working together since 2015 to compete in various robotics competitions, and they are now in their second year as a *FIRST* Tech Challenge Team. Team members are grateful to have learned so much through years of competing with *FIRST*, and they love to experiment and try new things. In addition to STEM, the team is very passionate about giving back to their community. As a team, they have learned the value of working together and the powerful impact that technology will continue to make on the world.

**Scollioxercise** targets those affected with Scoliosis, a condition where the spine has a sideways curvature. Exercise helps to alleviate pain and the further worsening of the condition, but it is essential to understand the limits of one's body. Scollioxercise is personalized for each user and uses resistance bands attached to a vest with pressure sensors to monitor the pressure being exerted on the spine. This allows people with scoliosis to exercise and strengthen their back and arm muscles in a controlled manner, without the risk of damage.

## 11997 - Heights Techies, USA Improving Blood Circulation for Wheelchair Users

The **Height Techies** (team #11997) is a robotics team at University Heights High School in the South Bronx neighborhood of New York City, which sits in the poorest congressional district in the country and has served as a gateway of opportunity for many minority and low-income students. With robotics, students from ninth to twelfth grade learn the engineering design process, CAD software, Java programming language, collaboration, and entrepreneurship. The Heights Techies strive to be active participants in the engineering community through their work with other robotics teams, mentors, and schools, and being part of the *FIRST* community has provided an opportunity to realize this goal.



Sitting for prolonged periods of time causes wheelchair users to suffer from poor blood circulation in the lower half of their body, which leads to a variety of health complications such as fatigue, digestive issues, a weak immune system, chest pressure, decreased cognitive ability, cold extremities, skin discoloration, leg ulcers, organ failure, and cardiovascular diseases. This solution effective, and affordable wearable electronic system of smart textiles (**WESST**) that uses conductive fabric clothing to generate electrical muscle stimulation. The device, embedded in everyday clothing, creates electrical pulses that mimic the action of electrical signals coming from neurons. These mild electrical currents target the muscles and nerves causing repeated muscle contractions and improving blood flow.

## 18225 - High Definition, USA Heart-and-Sole



Team 18225 **High Definition** from Bellevue, Washington is composed of 11 students, ranging from grades 7-11 united by our passions for STEM and learning. They are dedicated to all the components of being a *FIRST* team, from building a highly competitive robot to reaching out to their community. The team's main mission is to make STEM educational opportunities more accessible for all students by hosting free Connecting with Professionals events and coding workshops. Within the team, communication is their cornerstone value. While each member has diverse perspectives and interests ranging from engineering to business to education, the team sees these differences as strengths, since they can all learn from each other's motivations, interests, and challenges.

One of the most underutilized yet accessible ways to improve one's mental and physical health is walking, but too often, people push away walking because they label it as "boring." **Heart-and-Sole** is a one-of-a-kind mobile fitness app that combines fun and adventure with walking. With 6 different modes, using GPS technology and geotagging, this app generates a unique path for users to walk based on entered specifications and provides puzzles and challenges sponsored by businesses that are unique to a specific location. Heart-and-Sole provides a medium for users of all walks of life to use on their journey to maintain their physical and mental well-being. Holy walk-amolie!

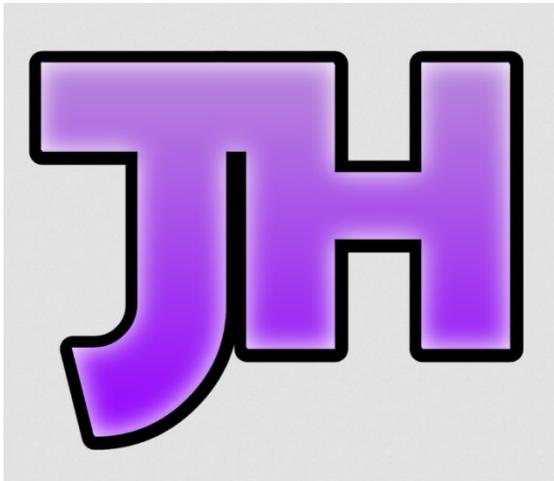
### 11039 - Innov8rz, USA

#### DigiHealth: Health like never before

**Innov8rz** is a team of passionate junior and high school students from Fremont, California. Founded in 2016, the team is proud to boast numerous awards. They are not only passionate about building world-class robots but equally passionate about sharing their learnings and excitement with their community. The team has started various unique initiatives such as the Foster Kid, Special Education, and Low-Income Family Initiatives where they inspire and help students who are underprivileged and don't have access to robotics. This season, everyone suffered from the consequences of COVID-19, and Innov8rz developed a unique solution, called TeleDrive, which is helping 120+ teams drive their robots remotely during the pandemic.



**DigiHealth:** "Health like never before" presents a unique solution that takes a holistic approach towards making people healthy. The app starts with a quick questionnaire used to determine the user's personal goals and restrictions which are then used to tailor the best diet recommendations and exercise routines that complement each other to maximize their health improvement. Along with this, users can also view their progress with intuitive graphs. To tie in mental health, the app includes anonymous community channels to discuss issues and encourage others.



### 14725 - Java The Hutts, USA

#### **PATHWAYS: Mobility Tool for the Visually Impaired utilizing Ultra-Wideband radio beacons for accurate locational determination.**

Team 14725, **Java The Hutts**, serves as a major catalyst for youth STEM opportunities in Fort Myers, Florida. Current members consist of three high school students, who use the relatively small size of the team as an advantage, mastering each specific interest and relaying information between each other with ease. In this strategy, the has found much success, as this structure promotes commitment to hard work and individual growth while still allowing members to specialize in engineering skills crucial to our future careers. Since the founding of the team, three years ago, the team's

main goal has always been to spread awareness of robotics and get more students involved with *FIRST*.

To solve the problem of the lack of tools for the visually impaired, **PATHWAYS** is a UWB detector device with an integrated vibration motor module. When attached to the user's cane, it automatically runs our novel software. Through software, the device incorporates an interface that scans for UWB beacons, using the detector built into the device, and forms a virtual boundary. By limiting the user's space through the use of this boundary, a safe path is developed and protection is ensured. The goal is to increase access to fitness by making a reliable direction guide so the visually impaired may remain both safe and confident in their personal navigation.

**15465 - K.R.A.S.H., USA**

**KEBB - KRASH Engineered Boxing Bag by Team 15465 KRASH**

**Team KRASH** is made up of five 6th graders and six 8th graders that attend Highlander Way Middle School in Howell, Michigan. In their 3rd year as a *FIRST* Tech Challenge team, they have carried the excitement of previous years' successes into this season, and are proud to be able to say that we have received many awards in our two qualifying competitions. The team likes to work hard, have fun, and be involved in their community - their community outreach efforts are what led the team to the idea for their Innovation Challenge Submission.



**KEBB (KRASH Engineered Boxing Bag)** is designed and programmed to specifically help regress the symptoms of Parkinson's disease. Working with Ohana Karate's Rock Steady Boxing program in Howell, MI, the team learned that patients can regress the symptoms of Parkinson's Disease by combining physical and cognitive activity—and that's exactly what KEBB does. KEBB will be made by putting LED lights on a boxing bag and making them light up in different places. These lights will tell the boxers which area to punch or kick. While KRASH is working on a final prototype for a local karate dojo, future plans will allow Rock Steady Boxing programs across the country can benefit from the design.



**3415 - Lancers, USA**  
**Fitness Frenzy**

The **Livingston Lancers**, from Livingston, NJ, consists of freshmen, sophomores, and juniors, from Livingston High School. The team is made of individuals that put hours into making robots, balancing both fun and progress on their shoulders. The team is divided into their best skills: Code, CAD, Logbook/Outreach, and Build, with coders working on programming, such as controlling the robot's movement, actions, and ability to detect objects and/or colors, CAD-ers creating designs for the robot that help the robot's builders visualize the final product, Builders determining if the robot would be functional, and those who maintain the logbook creating logs or summaries of every meeting conducted. Although divided into tasks, the team prides themselves in always coming together to create an amazing robot.

The **Fitness Frenzy** project uses limb bracelets paired with a phone app to promote exercise using the addictive power of video games. Players can play together or by themselves, and in their homes or outside. They can even play with each other across the world. It uses motion tracking technology, with AI processing in order to detect exercises. It can even be used by coaches to determine accuracy of a sports technique. The Fitness Frenzy app and limb bracelets have the potential to help solve the world's laziness epidemic and help children have fun again with the power of gaming and exercise.

**18433 - MakeShift Tech, Canada**  
**Paws Abilities**

**MakeShift Tech** works closely with *FIRST* Robotics Competition Team 4039 from St Mary Secondary School in Hamilton, Ontario, Canada. The team is in their rookie season, and while veteran *FIRST* Robotics Competition team members helped to support the team, they are proud to have completed this project as a newly formed robotics team. The team focuses on building competitive robots and using those same skills to create projects that benefit humanity by engaging in student-driven activities that shift the perception of science and technology, by leading STEM projects that improve people's lives, and by developing student as STEM leaders. They believe their team members can change the world!

Teens suffering from ADHD, ADD, depression and anxiety need help planning activities that keep them on schedule and active. **Paws Abilities** is a product created by teens for teens and introduces a new app for the teen's phone that allows them to be rewarded for the timely completion of tasks with enhancements for a virtual pet of their choosing. This app encourages the user to think about the things that make them feel well and then schedule those actions into their day. It also tracks their progress and links to their support network when things are not going well. **Paws Abilities** is a playful and fun way to keep the user engaged but also serves a valuable purpose in encouraging healthy behaviour patterns and increasing their paws-abilities of success in the areas of happiness, hunger and health.



**16884 - Mechanical Advantage, USA**  
**Encouraging Physical Activity in Autistic Children Using Personalized Gamification App**

**Mechanical Advantage**, Team 16884, is creative, compassionate, and collaborative. Team members prioritize the use of skills learned while building and competing robots in *FIRST* to bring quality STEM opportunities to underserved communities. The team has founded and continues to support *FIRST* based robotics programs at Title 1 schools in California and in countries in South America. During the pandemic, the team proudly used their CAD and 3D printing skills

to make Personal Protective Equipment for first responders and essential workers and to provide education opportunities to hundreds of school children studying remotely from home. Through *FIRST*, the team recognizes their ability to have a lasting impact that will help students like them dream big, reach farther, and accomplish great things.

Lack of exercise in the ASD community has been correlated with increased incidence of diseases such as obesity, diabetes, and heart disease. This solution is a mobile application that uses the unique traits of children with ASD to create a personalized gaming experience that rewards steps walked, jogged, or run with earned time to play a hidden object game. The application uses customer feedback to guide internet searches to locate and hide objects of interest within visually interesting backgrounds. By making exercise a fun and personalized experience, the application seeks to improve health outcomes in the ASD community.

**19030 - Team Supercalifragilisticexpialidocious, India**  
**H.O.P.E - Humanly Operable Programmed Exerciser**

**Team Supercalifragilisticexpialidocious**, from India, is comprised of ten high schoolers fascinated by technology & innovation. The team stays connected by meeting regularly and gaming together online. Over the last 3 months, the team has grown a lot closer, learning to cooperate effectively and work together. Each team member complement the others and they have learned many skills throughout the season, such as design skills, confidence, and enterprenuership skills. The team live by only one rule, "whatever you do, do it in a supercalifragilisticexpialidocious way!"



**H.O.P.E. - the Humanly Operable Programmed Exerciser** is a Portable Robotic Rehabilitation System that can act as an artificial physiotherapist at an affordable range for all. It is detachable and light-weight, and it simplifies the process of continued physiotherapy for its users. The accompanying app allows physiotherapists to monitor their patients' progrevss and ensure consistent exercise with two modes. It also allows physiotherapists to prescribe exercises and set thresholds for their patients to meet. Additionally, the app also has a variety of exercises for the user to choose from and an emergency stop button to ensure safe practice in the self-train mode.



**8565 - Technibots, USA**  
**Burt's Helping Hand**

**The Technibots**, Team 8565, is a team of 14 high-schoolers based in Plano, Texas. Since its founding in 2009, team members have participated in *FIRST* LEGO League Explore and Challenge in addition to their seven years as a *FIRST* Tech Challenge team, during which time, the team has spread the

excitement of science, technology, and engineering with *FIRST*.

The team is very proud of their many awards an world record! In 2020 under pandemic, we used our resources and robotics knowledge to help others in our community through 3D printing PPE, with 2000+ face shields, 3700+ ear guards donated to 40+ hospitals/clinics.

**Burt's Helping Hand** is a solution to build custom-designed training devices in the form of toys to engage the Developmental Coordination Disorder (DCD) kids to play while targeting a specific motor skill. It uses constant sensor feedback and performance history to regulate the learning process into one that is gradual and self-adaptive, eliminating the need for therapist sessions for DCD kids and assisting the kids in progressing at their own pace, catering to their abilities. With early intervention during childhood while their brain nerves are still forming, these fun training devices can help improve their motor skills which has a tremendous impact on their adult life.

## 16656 - Thunderbots, USA

### UMuscle

**Thunderbots** is a community team of 7 high schoolers based in Sacramento, California that has been a part of *FIRST* since 2013, participating originally in the *FIRST* LEGO League. In 2018, the team was graciously named Global Innovation Semi-Finalists & so as Innovation Ambassadors, they made it their goal to stay true to the “Thunder” in their name and bring the THUNDER about *FIRST*! They created a non-profit, STEM Universal Reach Foundation (SURF), to help create *FIRST* teams globally. They have also created an *FIRST* curriculum for schools and created a website called ThunderPortal to take our curriculum worldwide. This has allowed the team to mentor and start teams in Sacramento, across the US, and across the globe in India, Turkey, Kenya, Slovakia, Greece, and Dubai. They coined #FIRSTFIGHTSCOVID and volunteered (donating 1000+ lbs. food, 20000+ masks) and were featured in a Purpose 360 podcast showcasing “*FIRST* is more than robots.”



Muscle atrophy is a problem faced by mobility-limited patients, the elderly, and over one-third of US adults that do not exercise regularly. The **UMuscle** is an innovative self-learning system, combining EMS & EMG, to change the game for athletes, the elderly, patients, frequent flyers, astronauts, and all people. It combines Electrical Muscle Stimulation (EMS: sends electrical pulses to the motor nerves to exercise muscle fibers), and Electromyography (EMG: monitors muscle contraction), to prevent injury and strengthen muscles. UMuscle innovatively uses EMG to detect muscle fatigue and issues warnings to prevent muscle injury, and uses machine learning to recommend customized EMS programs for each user. The risk of Deep Vein Thrombosis on long-distance flights can also be mitigated by UMuscle.

# **FIRST<sup>®</sup> Robotics Competition**

## **FIRST<sup>®</sup> Innovation Challenge presented by Qualcomm**

### **20 Finalists**



#### **1374 - Amped Up!, Canada**

**Dean's Arm - Helping Powered Wheelchair Users Gain Greater Independence.**

Team 1374 **Amped Up!** was founded in 2016 by 10 students from Oakville Trafalgar High School (OTHS) to build a *FIRST* team fit for everyone. The name “Amped Up!” was chosen as a reminder of the importance of “Making it Loud” by sharing *FIRST* in the team’s community. Meanwhile, their motto: “Resistance is Futile,” is twofold – it is a reminder to the team that one can’t help but have fun on a *FIRST* team while combining passion for STEM concepts. For the past 5 years, 1374 has worked tirelessly to promote Equity, Diversity & Inclusion (EDI) within *FIRST* by publishing accessibility guidelines for *FIRST* competitions, and now by designing Dean’s Arm to improve Dean’s life.

Dean is just 1 of the 17.5 million wheelchair users worldwide without access to the assistive technology required to lead an independent lifestyle. Dean has cerebral palsy, and as a result of expensive and complex technology, his dream of taking out the garbage on his own is out of reach. 1374 is Amped Up! to assist him by creating **Dean’s Arm**, a robotic arm easily attached to powered wheelchairs, providing users with independence and confidence. This accessible, adaptable and affordable arm created for Dean, and various other user groups like para-athletes, can assist users in achieving their optimum physical and mental health through movement.

#### **3792 - Army Ants, USA**

**SPOCKS (Sensor Platform for Orthopedic Compliance after Knee Surgery)**

**Army Ants** is a community team based in Columbia, Missouri. The team started in 2010-2011, and currently consists of a diverse group of 35 high-school and home-school students, including 13 girls. The team is mentored by professional engineers and scientists and operates out of facilities provided by the University of Missouri, and is managed by the Columbia Educational Robotics Foundation (CERF), a 501(c)(3) non-profit and is a 4H-affiliated club. Through CERF, the university, and community partners, the team works to promote diversity and provide opportunities to underrepresented groups in STEM by hosting several outreach programs.



**SPOCKS (Sensor Platform for Orthopedic Compliance after Knee Surgery)** utilizes cutting-edge sensors to monitor clinically relevant parameters in nonclinical settings (at home, at work, during recreation) to encourage patient compliance with prescribed activities following total knee replacement surgery, with the potential to reduce the cost of recovery. It monitors leg activity by measuring knee range of motion, weight bearing, and

quadricep activation. By integrating biomedical sensors into wearable compression hosiery, SPOCKS can record and communicate key recovery indicators through patient- and clinician-facing applications.

#### 6479 - AZTECH Robotics, USA

##### Swish! Connect: Master Motor Skills through Adaptive Technology



**AZTECH Robotics** is a robotics club based out of Corona del Sol High School in Tempe, Arizona, with a goal to advance students' understanding of engineering, design, programming, and business through participation in the *FIRST* Robotics Competition. The team is broken down into multiple sub-teams such as Programming, CAD, Mechanical, Business, and PR, with members who specialize in many areas to create a highly talented environment. The team is proud to have a strong mentor support from teachers, parents of team members, and industry professionals from their sponsors. Utilizing

the tools provided by their sponsors as well as incredible mentorship, we are able to foster growth in all our students. "We aren't changing the world, we're creating the people who will."

**Swish! Connect** aims to help special-education children develop their motor skills in an engaging way, helping their ability to easily and independently complete daily tasks. There are 3 key components of this project: an auto-adjusting basketball hoop, an app, and a website. The hoop moves relative to the ball, increasing the chances of making a shot, facilitating higher motivation. The hoop is paired with an app, which adjusts the hoop in real-time and collects data on overall accuracy, that is then synced with the website with a therapist dashboard, allowing long-term tracking of user progress and gives activity suggestions to improve lacking motor skills.

#### 5940 - B.R.E.A.D., USA

##### Circulatio: Thermal Wear with No Fear

Founded in October of 2015, Team 5940 **BREAD**, which stands for Breakthrough Robotics Engineering and Design, is based in Redwood City, California, on Oracle's campus. With 55 active members from Design Tech High School, BREAD boasts a nearly equal girl to boy ratio. Team 5940 is a completely student-run and operated organization and has participated in six seasons of *FIRST* Robotics Competition. Team members are encouraged to explore STEAM and design thinking through firsthand learning opportunities. BREAD has over ten different subteams for students to join, covering various fields including STEM, business, journalism, and graphic design.



Many individuals have voiced that physical activity during their periods is a difficult task because of menstrual cramping. To combat this discomfort and inconvenience, **Circulatio** is designed to be an innovative and convenient wearable technology. Circulatio are compression sportswear leggings/biker shorts that reduce the pain of menstrual cramps with insertable electric heat packs around the waistband and other pressure point areas around the lower part of the body. The heat packs are made to insure the user's safety and comfort through its placement and portable charger design. The garment's fabrics (x-static, merino wool, spandex) are proven to control odor, temperature adjusting, and flexible.

**5406 - Celt-X, Canada**  
**LightPad**



**Celt-X Robotics**, pronounced: *sell-tex*, is a Canadian team, based out of Hamilton, Ontario, and was founded in 2015. They are a highly competitive team while embodying

gracious professionalism. The team is all about collaboration and sharing, which aids the sustainability of the teams initiatives and those of the teams that they work with. Celt-X created the Robodrome and opens its doors to other teams, inviting them to use the full shop and field, to practice, share ideas, and form connections. Celt-X teaches skills from day one through workshops and making safety bots. Fun fact, the team name is a cross between Space-X and school team the Bishop Ryan Celtics!

There are a lot of products aimed at people who want to be active, however, many people do not want to go out of their way to exercise. **The LightPad**, is a simple, touch activated, multicoloured light system, that is affordable for all demographics looking to get moving, and have fun. This product is usable by almost anyone, but especially designed to help inactive people take their first steps into the world of fitness. The LightPad is easy to use, offers online games, and has a built in reminder feature to alert the user when it's time to take a break, get up, and start exercising.



**7504 - Cybearbots, USA**  
**Way-to-Go Cane**

The **Cybear Bots** team mission is to move past the traditional classroom, be more inclusive with students, and encourage community collaboration, while immersing themselves in STEM. The team allows students from all walks of life, from every clique you'd find in a typical high school, to come together. On Team 7504, there's a job for everyone, no matter if they're into art, journaling, coding, or building. They strive for productivity, inclusivity, and collaboration, especially within an era of a global pandemic and working from home. Their team experiences have provided many opportunities to grow, inspire, and prosper within their community.

The a standard walking cane does not allow users to detect objects above waist height, as most are used to detect objects on the ground and the orientation of the user. The **Way-to-Go Cane Attachment** will give the user vibrational feedback on obstacles, guiding them to their destination. The attachment includes: a lightweight battery, a motor, ultrasonic sensors, bluetooth transceiver, and a microcontroller, all implemented for accessibility and ease of use. The fitting cane attachment also includes additional features for comfort, such as a sweat resistant band which aids the user with a stronger grip, and an outverted handle that makes it easier to hold onto the attachment.

**8621 - KITS Angels FRC Akola Team, India**  
**MULTI CROP SEED SOWING MACHINE**

#8621 is all girls team from farmer and labor community. They are highly determined to make a change in society, with each team member believing in her own strength and motivating others to learn the same. They are proud to have the engineering attitude, striving for great results with few resources. Their motivation for positive change has helped steer them on their innovative journey this season, utilizing a diverse set of skills and tackling each component as a team.

**The Multi Crop Seed Sowing Machine** is an affordable and easy to maintain system, which contains a feature for farmers to monitor and count seed per acre required to sow, minimizing any seed waste. It is a light-weight, hand held and hand driven machine that does not require any specific training to use. This machine is equipped with adjustable setting for sowing depth and has interchangeable roller dispensers for various crops seed depending upon their size of grains.



**7480 - Machine Mavericks, Canada**  
**AquaCue – A Swim Guide for the Visually Impaired**



**AquaCue**

**Machine Mavericks** is Kingston's newest *FIRST* Robotics team and is made up of students from four different high schools and community organizations. It prides itself on being the creation of two female students and actively strives for parity in STEM fields.

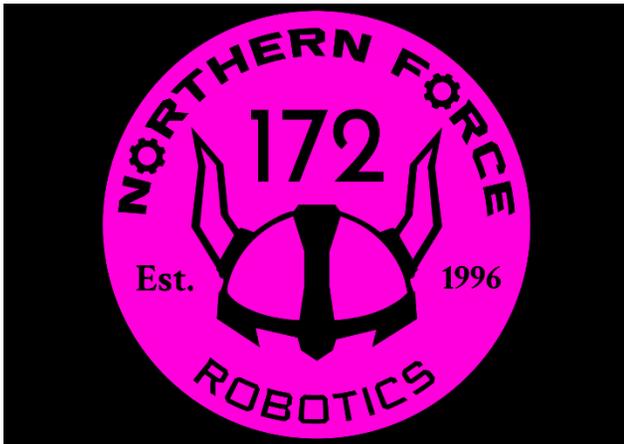
**AquaCue** – Sonar positioning technology integrated into a standard swim cap cues swimmers with visual impairments when they need to turn around in their lane. It consists of a set of four ultrasonic beacons permanently mounted in the pool area, which communicate with a swim cap containing an ultrasonic sensor and a waterproof Bluetooth headset. The system tracks not only the swimmers' position and direction but, using the built-in IMU, also identifies the stroke they are using and their efficiency in performing it. AquaCue allows visually impaired swimmers to swim on their own or in the company of others, without having to rely on tappers to keep them safe.

**6418 - The Missfits, USA**  
**PØP**

Founded in 2016, **The Missfits** is the first and only all-female robotics team based in San Francisco. They are a student-led community team that accepts any interested member from the local area, with girls from 15 different high schools currently. Their aim is to show girls how fun and rewarding engineering can be. During the 2019 season, the Missfits had the pleasure of having Ellie Wen, an award-winning filmmaker, film a documentary about them. It follows girls on the team through competition and through navigating life as teenagers. The documentary has been shown at numerous film festivals and won many awards!



**PØP** provides a way for families and/or groups to stay physically active together and have fun doing it from the comfort of their own homes! Interactive game pieces turn any open space into an active board game, with each player moving around and interacting with the game pieces or “bubbles.” The bubbles consist of a hexagon base that sticks to flat surfaces such as tables, counters, floor, and more. The top of the base includes various input/outputs (switches, buttons, levers, etc). Each bubble includes speakers and LEDs which serve as a function for the game. The customizable layouts and accompanying app allow for ENDLESS PLAY.



### 172 - The Northern Force, USA The Seeing Wall

Team 172, otherwise known as **The Northern Force**, is an *FIRST* Robotics Competition team made up of schools in southern Maine, primarily Falmouth and Gorham High school. The team was founded in 1996 and has been active almost every year since. It is important to Team 172 to make sure all kids and adults, no matter the background, have an even playing field no matter what they are doing. The two biggest goals at team 172 are: the kids have a chance to do everything they want to do, and most importantly the kids and adults have fun. The team tries not to make everything about

the robot but about the experience.

The **Seeing Wall** project is a product that is meant to level the playing field. It helps people with visual impairments climb portable rock walls and rock walls in rock gyms using sound and haptic feedback. It integrates with existing rock gym technology to add audio guidance from the rocks themselves, while providing haptic feedback to the climber via wrist and ankle wearables. The Seeing Wall project uses technology such as an Arduino nano, a Hall Effect sensor, buzzer, and a small rechargeable battery for the wearable components and can be added to existing fixed and portable walls.

### 8 - Paly Robotics, USA SightWalk

Paly Robotics is dedicated to enriching the educational experiences of our students and community by increasing STEAM exposure and inspiring others through *FIRST* programs. The team enhances the educational experiences if members through a student-led structure, which lets students plan, execute, and review all team operations. In the past, the team has collaborated with AbilityPath, a local nonprofit helping students with disabilities, and they are currently building sensory rooms and hand gesture-controlled RC cars to provide enriching educational experiences to their students. The team is also proud to have worked with quadriplegic individuals through their Helping Henry and Assisting Arnoldo projects, through which they built devices to help two individuals communicate with others.

**SightWalk** is a visual assistance and sidewalk navigation device that helps visually-impaired individuals navigate outdoor environments. SightWalk uses neural network models that detect objects, such as people, cars, bikes, street signs, and more, and a custom trained deep neural network model to determine an individual's position relative to a sidewalk. While the user is



walking, a chest-mounted device using camera data evaluates the user's surroundings and determines if the user is approaching a hazard or has drifted onto the road. The program sends signals to the chest-mounted device that vibrates and gives audio cues to alert the user of potential concerns, helping users safely exercise outdoors without the assistance of guides.



### **3616 - Team Phenomena, USA** **“Pheno-Advance 3616”**

Team 3616 **Phenomena**, from Lafayette, Louisiana, began in 2011, and currently consists of 20 student members (9 girls/11 boys) from six high schools in their area and 15 mentors. Though it is free to join the team, membership requires a passion to encourage others to promote STEM/Robotics (mentor through mentorship), and members encourage and recruit students who are passionate about STEM and robotics to be part of 3616. Team Phenomena is dedicated to spreading STEM and robotics awareness; creating a world where young people celebrate Science, Technology, Engineering, and Mathematics (and robotics). They continue to be a catalyst for culture change through hosting robotic tournaments, math tournaments, science fairs, community outreach

activities, STEM camps, and virtual opportunities.

**Pheno Advance 3616** is a pedal assist device equipped with: assist motor, sensors, modified platform pedal, angle assist, mechanical advantage, microprocessor, performance tracker, speed and breaking related safety components, and a low speed start button. This device can be added to any size bicycle to empower children with an impaired leg to become more active, allowing them to ride a bike just like their peers while gaining exercise and strengthening their cardiovascular health. Because a standard bicycle pedal is not accommodating, the modified platform was created as a place to rest the compromised foot, ensuring safety. While in use, the motor is activated to assist the compromised leg with operating the bicycle pedals whereas the motor is deactivated when the uncompromised leg is operating the pedals.

### **4586 - PRIMO, Israel** **EasyMotion**

**Primo** 4586 is a robotics team that was founded in 2013 by four ambitious students who finished the *FIRST* LEGO League program and wanted to incorporate the *FIRST* Robotics Competition program into their school. Since then, the team has evolved and grown from twenty students to fifty students. The team recognizes the importance of mentors, alumni, parents and sponsors, who are all a part of the family of Primo. Since its inception, Primo has advocated the values of community and familyhood by fostering a culture of STEM into their surroundings. Members of the team gain knowledge about robotics, self-confidence, become leaders, collaborators and better citizens who value the importance of giving back to the community.



While working with their community and talking to elders in the city, the team noticed that there is a need for a wheelchair that will enable easy and effective indoor mobility for people with varied health conditions, resulting in mobility challenges. **EasyMotion** is a compact, electrical, wheelchair, designed to move easily and elegantly around obstacles while being simple to control with minimal muscle effort for the user, allowing them to move in an effective yet dignified manner in their own home.



#### **5553 - Robo'Lyon, France** **Walk Assistant**

**Robo'Lyon** is composed of seven high school students, including three rookies and three girls. The team uses an iterative method called the Scrum method, which consists of giving a role to each team member before forming small groups that will work on the progress of the project. It allows the team to manage their time as well as possible with phases of prototyping and periods reserved for their presentation. The fact that Parkinson's disease affects each team member in one way or another makes this project particularly motivating for the team.

Parkinson's disease already affects more than 6 million people worldwide. The **Walk Assistant** aims to provide a solution for patients suffering from Parkinson's disease who develop a "Freezing" symptom, i.e. sudden immobility that can last a few seconds or a few minutes: walking is then impossible, which can lead to dangerous situations, such as falls, and can cause the patient to limit or even abandon his or her movements. The Walk Assistant is simple to use, because it does not require complex settings like the models that fit on shoes, nor the presence of a cane, creating a hands-free solution, which significantly facilitates the patient's movement.



#### **4253 - Raid Zero, Chinese Taipei** **NATASHA (Neural-Network Augmented Therapy Assistance Stroke Healing Approach)**

**Raid Zero** (4253) was the first *FIRST* Robotics Competition team in the East Asia / Southeast Asia region. The team consists of extraordinarily passionate students and mentors who strive to improve expectations every year, which has earned the team multiple opportunities to participate at a competitive level. More importantly, their mission to equalize educational opportunities in STEM for all students has driven them to instigate and grow a STEM revolution their community in the past decade. They continue to take on the leadership role in this burgeoning *FIRST* community and aim to

continue to expand their reach across city and nation boundaries.

Instead of "doing" therapy, we "play" therapy. **NATASHA** is a universal online stroke therapy platform which offers a vast collection of games specialized for stroke rehabilitation. Patients can play these games at any time, anywhere, by simply connecting a portable TPU device to their mobile device webcam, which then readily detects the user's motion. NATASHA makes recovery possible for all stroke victims by drastically reducing its cost and elevating its accessibility. It empowers every patient to embark on their path to recovery, guided together by our AI machine learning algorithm and professional therapists to optimize the user experience and therapeutic effectiveness.

## 7563 - SESI SENAI MEGAZORD, *Brazil* PERSONAL ROBOT

**Team 7563 - SESI SENAI MEGAZORD**, proudly composed of 60% girls, emphasizes teamwork activities at every meeting to empower the members and strengthen the union. The team recognizes each member's unique skill in technical or social areas, and encourages them to grow by attending a technical course, allowing them to develop Gracious Professionalism®, leadership among all members, communications skills, solidarity, and a sense of responsibility. The team's goal is to leave a legacy in the world by impacting the lives of those most in need, and they focus on transforming each member into future leaders, and use this experience to change their path to a better future with many opportunities.



**Personal Robot** was created as an inclusive tool to help users, from children to elderly, hearing and visually impaired, and special needs people, stay active. This solution will analyze the user's movements and demonstrate right way of doing the exercise, making each workout much more efficient and safer. Based on the user's profile, the robot will provide a specific training, approach, and will feedback either through audio description or a smart devices connection, so the user will be able to follow himself on the screen. The Personal Robot will act as a training partner, sending reminder notifications to encourage and entertain!



## 971 - Spartan Robotics, *USA* T.E.A.R. (Testing and Evaluating ACL Risks)

Team 971 has always emphasized innovation with their robot design, and they enjoy stretching the limits of traditional mechanisms and creating designs that have never been used before. Within Team 971, two female and two male students, also members of 971's leadership team, supported by two mentors came

together to form the TEARS team. Between the four diverse students, they participate in a total of seven different sports, including soccer, basketball, tennis, softball, cross country, skiing, and track and field. As a result, each member has witnessed the impact ACL tears have on friends and teammates, which is a major reason why they chose to focus on this issue.

**T.E.A.R (Testing and Evaluating ACL Risks)** provides a simple yet elegant solution to a problem that many athletes, especially women, face throughout their careers. The cost of machines capable of measuring an athlete's Hamstring to Quadricep ratio, such as isokinetic dynamometers, is astronomical. By cutting out unnecessary features included in full scale isokinetic dynamometers, the team has built an inexpensive prototype out of sustainable materials. The design utilizes strategically positioned electronic force transducers allowing for accurate measurement of the strength of both the hamstring and the quadricep. By providing this service at an affordable price Team 971 believes that they could prevent ACL injuries for thousands of athletes around the world.

## 6652 - Tigres, Mexico

### Theraplay: revolutionizing the way that therapies are made

**Tigres** is much more than a Community Based Team from Mexico, we are 122 members from 22 different schools, an experience, an alliance of entrepreneurs that are changing your world perception. They are strongly based on teamwork, passion, STEAM, and innovation, as a result, we became a unique group of people that are actively helping, empathizing and changing the world by making a direct impact through outreach projects, events and programs.

The team has become a huge platform with the main objective of supporting all age entrepreneurs, hard working people, troubled kids that are in the look for bettering themselves and finding quality education, willing and excited to revolutionize the way society views solutions to diverse problems.



**Theraplay** aims to change the reality of Physical Rehabilitation, especially to the most vulnerable ones. It is the ideal complement of physical therapy for children with a Musculoskeletal Disorder in the superior limb. This solution consists of two components, the *Picka-bot*, a modular device with 6 attachable parts that is used in MSD patients' therapies via challenges guided by the Picka bot's voice, and *TherAPPlay* app, in which patients interact with a community, get motivation, reminders and challenges, to do in synchrony with Picka Bot. The components work through Bluetooth connection, acquiring data, interpreting and adapting therapies and suggestions for each patient, adding values to their lives and recovery process.



## 2554 - The WarHawks, USA

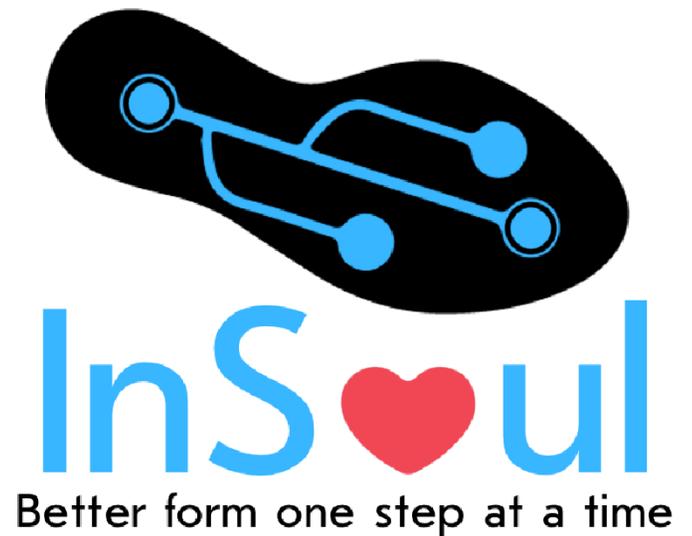
### VisualEyes

Team 2554, **The WarHawks**, is a team founded in Edison, NJ, with the objective of satisfying the engineering curiosity at JP Stevens High School. They focus on providing their team with a comfortable environment to foster teamwork and new ideas. As a result of this environment, team members actively bounce ideas off one another, leading to their best work. The team is organized into sub-teams, each focusing on one critical aspect of engineering. At the same time, the team keep the process enjoyable by constantly encouraging social interaction and collaboration; the hours upon hours they spend in the workshop fly by as they pursue our passion for engineering and robotics together. Through summer outreach programs, team members have developed a focus on bettering our community.

Faced by millions of people worldwide, visual impairment hinders individuals from living their fullest lives, motivating The WarHawks to create a revolutionary product: **VisualEyes**. VisualEyes aims to assist the visually impaired with navigation and object recognition in their immediate surroundings, providing them safety and security. A low-cost and easy-to-use product that serves in conjunction with the white cane, it incorporates an advanced AI-based object recognition system powered by ultrasonic sensors and cameras mounted on a hat, which constantly transmits data to an app equipped with customized instructions, accessibility features, and a multitude of security measures.

## 900 - The Zebracorns, USA InSoul

The **Zebracorns**, a *FIRST* Robotics Competition Team from Durham, North Carolina, began as a partnership between mentors and students at the North Carolina School of Science and Mathematics, but the team's membership is not limited to NCSSM residential students and the diversity of students on the team represents the whole of North Carolina, with students coming from the furthest corners of the state. The team's goal is to introduce students to engineering principles through practical application. When not competing, the team publishes technical white papers on their website and can be found presenting at conferences about their work with neural networks, teaching artificial intelligence for K-12 and ROS, the Robot Operating System.



**InSoul** is a digital shoe insole designed to keep runners in the race and people on their feet. InSoul incorporates machine learning to provide real-time feedback and uses an unobtrusive insole that analyzes running data. Using pressure and motion sensors, InSoul can analyze gait, cadence, stride, pronation, and much more to help avid runners avoid acute injury and optimize their running form, allowing users to see data describing their physical health and running habits and use it to improve their form, thus enhancing their physical and mental wellness. Future plans include expanding the use of current algorithmic models to include decreasing fall risk in the elderly and preventing chronic back injuries for nurses and other frontline workers.

