Mechatronics Engineering Capstone Design Projects 2015

Creatix Robotics: The Metal Maker
The Metal Maker is a 3D metal printer based on gas metal arc welding which can rapidly produce metallic prototypes for the everyday hobbyist or start up business. The printer uses a hybrid design to deposit weld metal on a base plate and machine away any excess material on specified surfaces. This design allows for the final product to be a fully functional prototype without worrying about cost of material or waste.

Anthrobot
Many environments are dangerous for people to work in. We solve this problem by creating a remote controlled robot that will manipulate objects in these kinds of environments.

PPC: Frost-E-Bike
Bicycle commuting is affordable, active and convenient - but it shouldn't have to stop when the winter comes! Enter the Frost-E-Bike. Sail through the winter season in comfort with heated handle-grips and a windshield. Conquer icy roads with our intelligent traction control and anti-lock braking systems. With our series-hybrid power drive and intelligent power transmission you don't even need a charged battery to make your commute!

iOIS Imaging System
Intraoperative Optical Intrinsic Signal Imaging System:
Identifying active regions during a brain surgery is currently done very crudely by using electrodes. This method has low resolution, and requires varying parameters for each patient. We are attempting to map active regions of the brain during a craniotomy by looking at the difference in oxygenation in the brain. This can be located using infrared filters and image processing techniques.

Altilium
A typical smartphone does not last through the work day on a single charge. In this digital age, the need for constant connectivity requires a method of charging a digital device on-the-go without being dependent on the availability of a power outlet. ALTILIUM is a cross-platform wireless interface that allows the transfer of charge between two devices.

Solar Tracker
Energy usage is dramatically increasing, causing the demand for renewable energy to increase. The area of greatest demand is solar energy, where there is a need for cheap and smart systems that maximally harvest energy from the sun. This project focuses on how such systems are developed, concentrating on the construction of the structure and tracking method. The project involves using sensors to detect the angle of incidence from the sun and positioning the solar panel along two-axis to ensure the panel is perpendicular to the sun to maximize energy absorption.

Teaspoon
Cooking and baking is an essential task for many families; however, a preparation for cooking or baking can take a long time. Much of this time is taken from measuring the different ingredients required for the recipe. In order to reduce the time and effort required for accurately measuring ingredients, team Teaspoon is designing a convenient and accurate automated system that minimizes the time taken to measure and dispense cooking or baking ingredients in many different units of measurements.

GeoSim
GeoSim is a physical 3D terrain simulator. There are a large variety of applications with such a device, including, Exploration Mapping, Military Simulations and Robotic Vehicle Testing. To demonstrate the applicability of a terrain simulator, we have chosen our target application to be a golf putting system where users can modify the course layout as desired.

SSMS: Library Vacancy Detection System
Students often have a hard time finding empty study spaces on campus, especially during exam times. SSMS is a system that accurately detects occupancy status of study spaces on campus, and displays the vacancy status of libraries through a web application for easy access.

HaVRoc
Virtual reality is becoming increasingly popular, especially since the advent of the Oculus Rift, which brings the VR experience within the reach of the everyday consumer. A lot of research has been conducted in this field to create an immersive experience, however, the spatial aspect of VR has not been heavily explored. HaVRoc aims to create a wearable device that provides haptic feedback from VR interactions. It will use miniature motors laid out densely on a custom suit that can be worn by an Oculus user. A simple VR boxing game will be created that can track the user through sensors on the suit, and translate any virtual interactions to the suit in the form of haptic feedback.

titan3d
The need for orthopedic implants is growing due to an aging population in the developed nations. Out of all the popular materials, titanium is the best when it comes to performance but the poorest when it comes to cost. To address this issue, active areas of development has been done in rapid prototyping of titanium. This is the focus of our project.

Precision Joe Bike Tools: Automated Truing System (ATS1)
Bicycle wheels work best when they're perfectly circular and planar, which is called being "true". Over time, impacts and vibrations cause wheels to develop wobbles. When the wobbles get bad enough, wheels are taken to bike shops where they are fixed by hand. This process, called truing, can take up to an hour and requires a skilled mechanic's attention. The goal of this project is to change the way wheels are trued. Using sensors to detect geometric deviations and a mechanism for adjusting tension in the spokes, the ATS1 takes the manual work out of wheel repair. Simply load a wheel into the fixture, start the machine, and remove the wheel when it's done.

Sharpshooter
Sharpshooter offers a proven way for basketball players from high school to college varsity teams to improve their shooting, the most critical aspect of the game. The Sharpshooter device sits right underneath the basketball net. It continuously tracks a player's location on the court using a stereo camera system and passes the ball on demand. It offers dynamic routines which allow players to customize their training on the go and practice shooting on the move. After each training session Sharpshooter displays a complete shooting sheet showing all the locations on the court where shots were made and missed.

CareChair – Transforming People's Lives
The CareChair is a device that addresses the risks associated from moving a person with reduced mobility from a bed to a chair and vice versa. It is the first standalone system that can function both as a

bed and a wheelchair. It eliminates the need for caregiver assistance and saves valuable time and space by transforming into a bed automatically. This, in turn, reduces the risk of injury, reduces the burden on the caregivers and increases the independence of the individual.

GRASP - Seamless Bicycle Security
Traditional bicycle security methods are clumsy, time consuming and simply not a seamless process for the many cyclists forced to struggle with them. Our solution is a bike lock that can be used with a single hand, thus reducing time and effort in securing the bike. This is achieved by using articulated mechanical components, biometrics and an embedded system to make the process efficient. This product is intended for those who rely on cycling for transportation but also anyone currently deterred from doing so due to the hassles of bicycle security.

Sewerbot
Municipalities are looking for a way to measure the infiltration flow rate and quantify the benefits of excavating and repairing pipe segments. This gives municipalities a better understanding of the yearly costs at any given infiltration point and acts as a method to assist yearly budgeting and expected infiltration costs and trends. We are focusing on developing a waterproofed robot that is controlled by an above ground operator and can traverse 200mm diameter pipes up to a distance of 110m. The primary function of the robot is to measure the flow rate of the groundwater infiltration points.

Real-Time Board System (RTBS)
Blackboards are widely used in many classrooms for teaching. With continuing rise of promoting collaborative learning, SMART boards have been on rise in many classrooms. However, replacing all the boards in classrooms is an expensive and time taking process. Our team aims to develop an affordable system to effectively capture and record real time content from conventional blackboards and make it available via online streaming for easy access to students.

BackUp: Posture Correction Device
For our fourth year capstone project (MTE481-482), we decided to design a device that would help its user correct and improve upon their posture. This project idea was inspired by the hundreds of students on campus sitting in labs or on benches hunched over looking at their phones. As the internet generation ages, it is expected that there will be health complications associated with poor posture, our project aims to preemptively remedy these complications through the use of a wearable device that notifies the user to correct their position when he/she has bad posture.

FeedOn
FeedOn is an autonomous robotic solution used for transporting small to medium sized items, for example, office buildings, hospitals, and factories. FeedOn has two main modes of operations: 'Door-to-Door' mode, where the robot travels around the building during peak hours to ask people if they want coffee and donuts and 'On-Call' mode where the customer sends a request for coffee or donuts and the robot delivers it to them. FeedOn is designed for busy environments to save people time so users can focus on priorities at hand.

FlashLAMP
FlashLAMP takes high fidelity genetic testing out of the lab and into the field allowing for farmers to rapidly identify crop diseases. Harnessing the LAMP (Loop-Mediated Isothermal Amplification) process, the device can provide feedback in 30 minutes on the presence of disease for less than $5 a test. This

allows farmers to make informed decisions on pesticide use and quarantine protocols to manage both their costs and damage from disease.

Revolute

Humans are in constant motion. Whether they are sitting down at a desk, or working in a garage, a person's head is never stationary for a long period of time. This can be irritating when one needs to follow detailed instructions, or if they are sweating from the heat and always moving out of a fan's airflow. Thus, our project focuses on designing a system that can track the movement of an object is necessary. As for its core functionality, having a removable head that can mount multiple devices is key in broadening its uses.

Brüster: A Fully Automated Coffee Kiosk

Introducing the Brüster Automated Coffee Brewing and Dispensing Kiosk. Efficiently delivering fresh coffee that's quick and convenient, presented with your choice of additives. No longer do you have to wait in those long coffee shop lines in the mornings. The kiosk brews a fresh cup of coffee on demand, and has customer options for adding milk, cream, and sugar. The kiosk even places a lid on the cup and stirs all the additives together before presenting it to you.

Autowalk – Walking Assistance for the Elderly

The loss of leg mobility due to muscle weakness or rehabilitation at the knee joint, reduces the ability to fully extend the legs while walking. Autowalk is a motorized knee brace to overcome this issue, known as flexion contracture, to allow users, particularly elderly people with leg muscle weakness, to fully extend their legs. It determines your intention to walk through leg motion and applies a small amount of motorized torque to the lower leg to allow you to extend your leg fully while walking. We believe that no matter your age, you should always have access to mobility and freedom to keep exploring.

MADD – Mothers against Drowsy Driving

The answer to preventing drowsy driving; MADD. This project is being designed as a solution for the safety of the public to prevent critical accidents when a driver falls asleep at the steering wheel. An assessment of the current traffic data states that there is no real solution to this problem that provides an ergonomic and seamless experience at an affordable price.

RangeRover Leash

RangeRover is a portable, wireless pet containment system that integrates directly with your smartphone to keep your pet on an invisible leash.

Smart Valve - MIG Welding Shield Gas Saver

The Smart Valve is a cost ¬saving device aimed at helping commercial and industrial MIG welders lower the cost of their consumables. It precisely controls the amount of weld shielding gas to maintain it at the lowest possible setting that still produces a good quality weld. Present technology only consists of gas flow regulators that are set manually to a certain flow rate and are left at that rate. This causes many welders to use much more shielding gas than is necessary. The Smart Valve system consists of an electronically actuated valve that the user installs between their shielding gas tank and their welder, and a sensor that wraps around either the power or ground cables. It is designed to be installed with little or no modifications to existing equipment, and will work on any available MIG welders, regardless of make or model. There are currently no similar products that are commercially available.

Laser Origami

An apparatus and method for forming a three-dimensional object from a two-dimensional planar object by cutting and bending with a laser beam. This is useful in the field of rapid prototype manufacturing (RPM) in which a computer-generated CAD file defining an object may be converted directly to the described object. Because only selective geometric lines are scanned by the laser beam, this process is much faster than other RPM manufacturing techniques where every point inside the shape being formed must be scanned. Objects having complex geometries and/or hollow interiors may readily be formed using the disclosed apparatus and method.

Boogaloo Bunks
Boogaloo Bunks is developing modular privacy pods that improve sleep, security, and comfort in shared sleeping spaces.

Pegasus : "High Endurance Survey Vehicle"
Current surveillance and surveying vehicles do not possess the endurance, range, or payload capabilities necessary for widespread industrial use. Our team has worked hard to develop a low cost, extremely high endurance survey drone that is tailored to industrial and surveillance applications. This will facilitate a broad range of new uses for small scale drones in addition to providing a platform that is better than existing solutions.