Manufacturing Engineering Tripos
DESIGN SHOW 2024

UNIVERSITY OF
CAMBRIDGE
Department of Engineering

IfM | MANAGEMENT
TECHNOLOGY
POLICY

MET

The Manufacturing Engineering Tripos (MET) course is a programme for 3rd and 4th-year engineering students who have successfully completed the first two years of an engineering degree.

MET takes the best engineers and provides them with the management competence, business acumen and interpersonal and organisational skills they need to become world-class leaders.

The Projects

Over the last year, teams of MET students have completed a major design project to develop a new product, with real business potential. Having first identified a customer need, they have researched the market, developed original design concepts and created a full business plan. The projects have generated some exciting new ideas and innovative technology.

Zenzy

Meet Zenzy, a cuddly robotic creature designed specifically for autistic children.
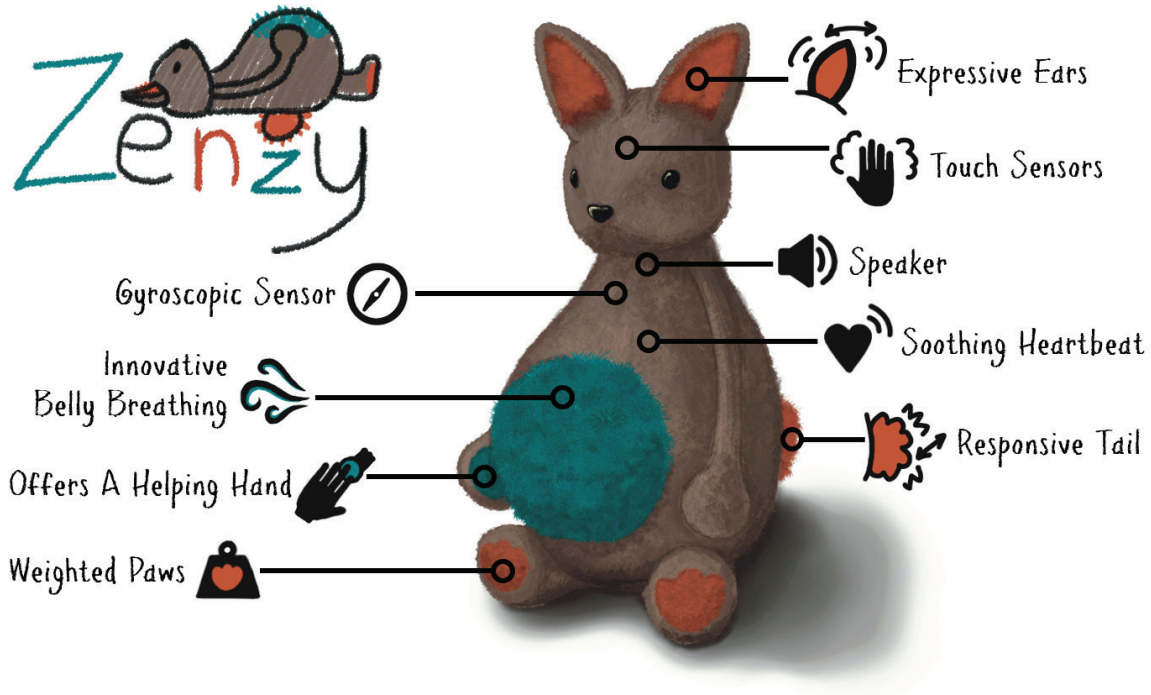
Inspired by animal assisted therapy, Zenzy is more than just a toy. Through considerate design we have captured many of the benefits having a pet can bring, whilst eliminating the challenges associated with caring for a living therapy animal.

In times of big emotions, Zenzy will always be there to lend a helping hand.

Zenzy incorporates scientifically proven techniques used to help calm autistic children, including a weighted design, a continuous calming heartbeat, numerous fidget features and most importantly its unique belly breathing technology. When your child tightly holds Zenzy's paws, its belly will start gently expanding and contracting to mimic the rhythmic pattern of diaphragmatic breathing. This tactile and visual guidance helps children effectively learn these essential calming techniques.

But Zenzy's role extends beyond tranquillity. With a plush huggable body and long arms, Zenzy is designed for play. Just like a real pet, Zenzy enjoys being stroked and when happy it will start wiggling its tail. Dynamic ear movements and subtle sounds also enable Zenzy to express feelings of comfort or dissatisfaction based on the child's actions towards it. This unique two-way communication helps foster emotional intelligence and exploration.

The ultimate goal of Zenzy is to be a companion for children that will offer comfort and support during tough moments whilst also encouraging playful exploration and social development.

Zenzy

- Expressive Ears
- Touch Sensors
- Speaker
- Soothing Heartbeat
- Responsive Tail
- Gyroscopic Sensor
- Innovative Belly Breathing
- Offers A Helping Hand
- Weighted Paws

Team: Alex Chilton, Miriam Eley and Amy Naden

GrowBot

The GrowBot is a controlled plant growth machine, allowing for climate conditions to be simultaneously maintained across multiple growth chambers. This will revolutionise science education, allowing students to design their own experiments and witness the impacts of different growth factors.

The GrowBot allows for automated climate control across a number of individual chambers. Each of the chambers can maintain independent climate conditions, with temperature, light intensity and colour, and rate of watering being remotely set and monitored by the student. A carriage head moves between modules to deliver water and to photograph the plant. Height and NDVI index are determined from the photographs and accurately measure plant growth and health. A dashboard displays the status of each chamber, with real time data updates.

The GrowBot can be integrated into schools' academic curriculum, allowing students aged 11-18 to explore experiment design by setting and testing their own experimental parameters and witnessing their impact. By containing multiple experiment runs in one remotely controlled unit, the GrowBot offers an efficient, safe, and easy way for students to learn about plant dynamics and inspire scientific discovery. Precise real time data eliminates time taken for data gathering, streamlining learning experiences and eliminating additional workload on teachers.

The current prototype demonstrates a 'proof of concept'. The product has the potential to be scaled, with the number of chambers customised to fit the school's requirements and budget. We aim to seek funding through Educational Foundations such as the Royal Society of Biology and through schemes such as Horizon Europe. Due to cost constraints, GrowBot will initially be sold to independently run schools. Following the first 24 months of introduction, we then envisage our product being bought by state-run schools, assisted by government subsidies.
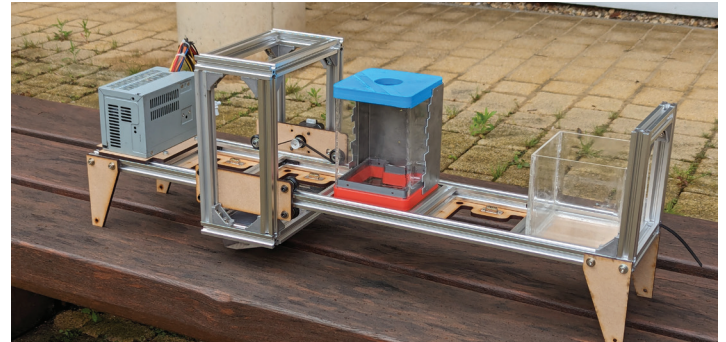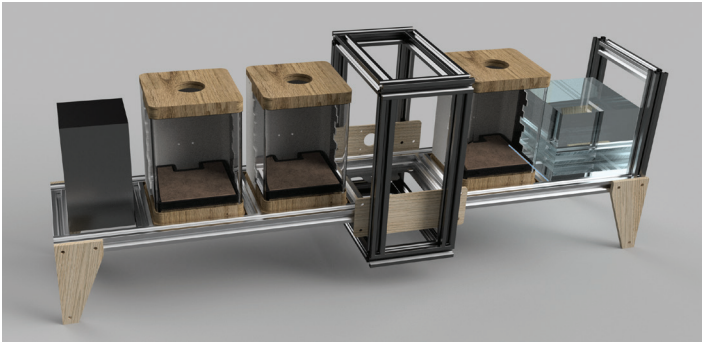
Team: Dom Dale, Aisling Day, Scarlett Irons and Yiheng Liu

Obal

Thinking inside the box.

Obal is the one-stop-shop sustainable packaging solution - it's a mechatronic device that can take any sized object (within set parameters) and package it efficiently using single-walled corrugated cardboard, creating right-sized packaging and eliminating excess space in the box.

Have you ordered a very small item and received it in a very large box? Currently, it is estimated that most companies are using boxes 25% bigger than required for their products; this leads to up to 25% fewer boxes being able to fit in a delivery vehicle, and additional materials like packing peanuts needed to fill excess space.

Obal aims to increase the efficiency of parcel delivery by creating right-size packaging. It reduces wasted space within packages and thus allows more items to be loaded and moved. Our modular mechatronic solution allows users to input their product dimensions, and then Obal calculates the optimal net size, cuts, folds, forms and seals the box. Obal's compact table-top design ensures it can complete multi-step tasks whilst fitting perfectly in a small space.

Our product is ideal for users dealing with a medium volume of high variety items, where we have identified two primary target markets. Obal is great for use in post offices, where people bring items of varying sizes and struggle to find suitable packaging for them. Obal can also be a helpful product for individuals selling used goods online through platforms like Ebay, Vinted and Depop, where different sized packaging is needed for the wide range of potential items sold. Obal is an accessible, intuitive and cost-effective solution to user needs.
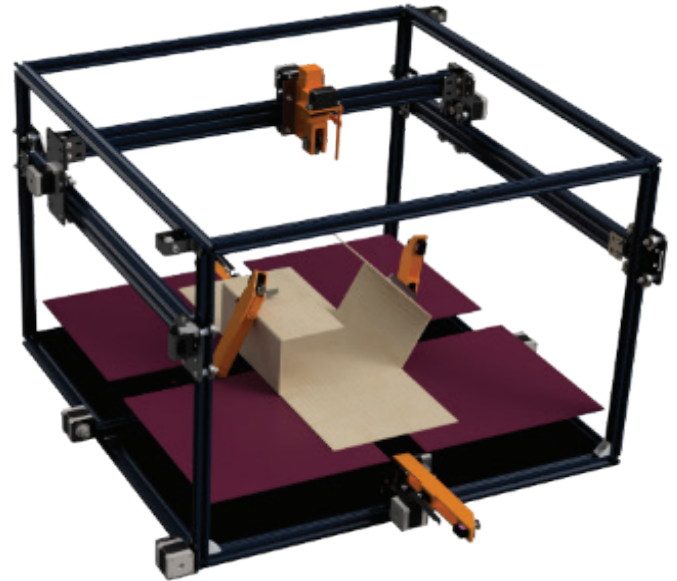
Team: Ayesha Karim, Mason Frudd, Kate Lucas and Alex Perrin

THEIA

THEIA is a new and improved cane for the visually impaired, combining mobility and sensing into one sleek design. Our assisted sweeping technology reduces the risk of repetitive strain injuries while the street-level ultrasonic sensing enhances the feedback of every sweep.

Canes are currently widely used among visually impaired people to sense the world around them and allow independence and safety when navigating spaces, but the standard cane is not much more than an aluminium tube that has barely changed in decades. THEIA was created to directly solve the problems that current cane users experience and fix the glaring absence of relevant modern technology in this area.

The assistive sweeping comes in the form of a motorised end tip, which reduces the effort required from users without overshadowing the familiar, real-time feedback provided by the cane itself. In the handle, functional yet simple controls give the user full control over how much sweep assistance they receive as well as the timing, allowing users to align the cane's movements with their stride. The accuracy of this timing is essential for proper cane usage, and our intuitive design ensures that this cane is quick to learn and unintimidating for new users, without requiring any extra training.

A street-level ultrasonic sensor provides tactile feedback to warn the user when dangerous trip-hazards, steps or drops are detected adding safety and reliability. Additionally, the long-life, rechargeable battery, fully waterproof design, and small packing size make THEIA convenient and reliable for real-life, daily use.
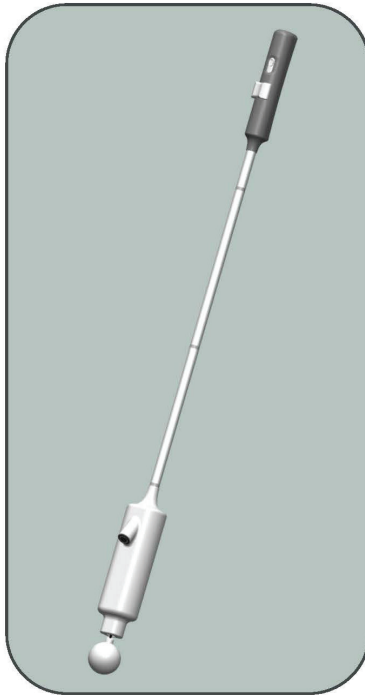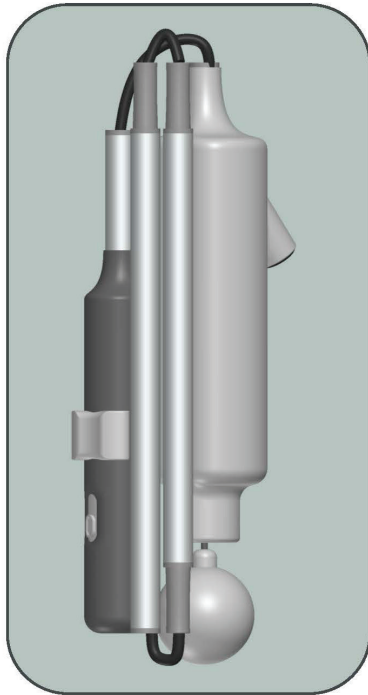
Team: Ria Bacharach, Emily Darnell, Duncan Greenshields and Anders Nielsen

Cycleaf

Cycleaf is an innovative machine to clean cycling lanes during the autumn months. It ensures a clear, safe path for cyclists and makes the cleaner's work easier and more productive.

The UK has an estimated 2,000 km of cycling infrastructure and more than 6.5 million annual users, of which 53% say that poor road conditions make them feel unsafe. During the autumn months, wet leaves are often left to rot on the streets, creating a dangerous slippery surface layer. Cycleaf helps local authorities and city councils fulfil their duty of keeping cycling lanes clean and in safe condition.

Inspired by the much larger street cleaning trucks, and redesigned to enhance its maneuverability in small spaces, Cycleaf is effective, affordable, and easy to use. By collecting the leaves instead of merely moving them to the sides of the paths where they can be blown back by the wind, Cycleaf makes cycling lanes stay clean longer.

Cycleaf has a double-stage system designed to maximise its effectiveness and the productivity of the cleaner. Its front brushes move in circles to remove leaves that are strongly attached to the ground, while the back rotating brush picks them up and deposits them into the conveyor belt. The leaves are finally deposited into a plastic bag that can be quickly replaced and disposed of by the operator once it is full.

Cycleaf can be used as a standalone device with assisted movement, or it can be adapted to be attached to the bike. It is ready to be sold to the public sector, to facilitate the work currently done manually, or to individuals who want to make a positive change in their community by keeping their cycling lanes safer.
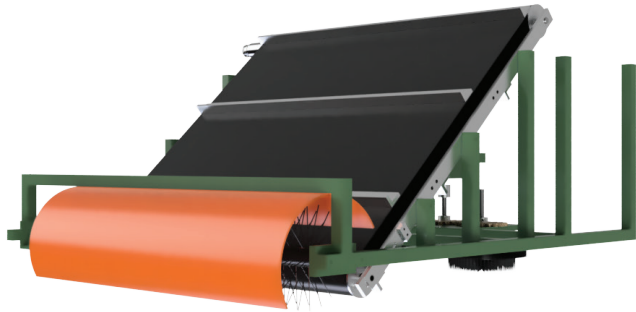
Team: Mercy Akinyele, Emilia Keavney, Drexel Loh and Javier Sanchez-Bonilla

Rise N' Step

Rise N' Step is an autonomous lift and mobility assistant to help elderly people with mild mobility problems stand up more comfortably removing the need for external assistances.

Rise N' Step consists of a linear actuator adjusting the height of the handlebars and arm support to lift a person from seated to standing position safely and efficiently. Handlebars have inbuild movement mechanisms and brakes, and their ergonomic design alongside the arm support ensure comfort even when used for long periods of time. Wheels allow for smooth and efficient navigation and have brakes to ensure safety. Whilst being easy and safe to use, we are passionate about helping users feel empowered and in control.

In a saturated market, Rise N' Step stands out from its competitors as it combines two very important motions: standing up and walking.

Most of the devices on the market are either walking frames or lift assistant. Our product combines both. Lift assistants on the market require an external operator increasing staff cost in care homes and making the users dependant on others. Our product will be fully autonomous with the ability to control the lifting motion using buttons incorporated in handles.

Proportion of world's aging population accounts for almost 10% of the world's population, and it's has been growing at an increasing rate and expected to hit 16% in 2050 and eventually 24% by 2100. The demand for aid machines to help the ageing population will also carry on increasing, especially with a focus on autonomous devices to help maintain autonomy and sense of self. Rise N' Step will kickstart the future by meeting these demands.

Current product on the markets fail to address both these motions simultaneously, something we are going to exploit to ensure we secure a customer base. There is a wide range in price point and quality for similar products on market, with very expensive high-end lift aids used in care homes compared to simple walking frames purchased for personal use. We aim to make our product durable yet economically accessible for a wide range of users including both care homes and for personal use.

Team: Musharaff Adetunji, James Gibson, Arzoo Iqbal and Annie Milhofer

Glidematic

Glidematic is a pioneering automated frisbee launcher, the first to offer controlled adjustments of firing angle. Our technology unlocks a new dimension of training possibilities for ultimate frisbee teams.

With the exponential surge in popularity of Ultimate Frisbee, we have noticed a discrepancy between the available training infrastructure and the expanding player base; more and more universities, colleges, schools and towns are forming their own Ultimate clubs, but lack the resources to cultivate those skills at a competitive level.

Our system gives players the ability to recreate the intricacies of an entire game, refining skills encompassing every aspect; from catching to cutting to diving. All done via remote control and a feeder that stores up to ten frisbees, we are helping teams cut down on non-valuable training time. Gone will be the days of inefficient training with inaccurate throws and time-wasting frisbee retrieval. We are paving the way for an era of precision and smart training, with the advancement of training technology at the forefront.

With our user-friendly interface, players can programme the launcher to fire with an exact pitch, roll and yaw, to mimic that of a person. This can be built up into a sequence of throws in various combinations. Our flywheel is engineered to send the frisbee in the same the arc in which it travels when being thrown by a player, creating a realistic training environment. The firing platform is crafted from recyclable polycarbonate; both light for easy transport, and frictionless to allow for an undisturbed flight path. The launcher will also be equipped with locking wheels and a height-adjustable frame to cater to teams of all ages. Our innovative tilting platform technology, based on parallel manipulator systems, is capable dynamically adjusting firing angles with unparalleled precision and agility, ensuring optimal trajectory control for each throw.

Glidematic ensures an engaging and immersive training experience for every member of the growing Ultimate community, and its novel technology has great potential to improve the landscape of training.
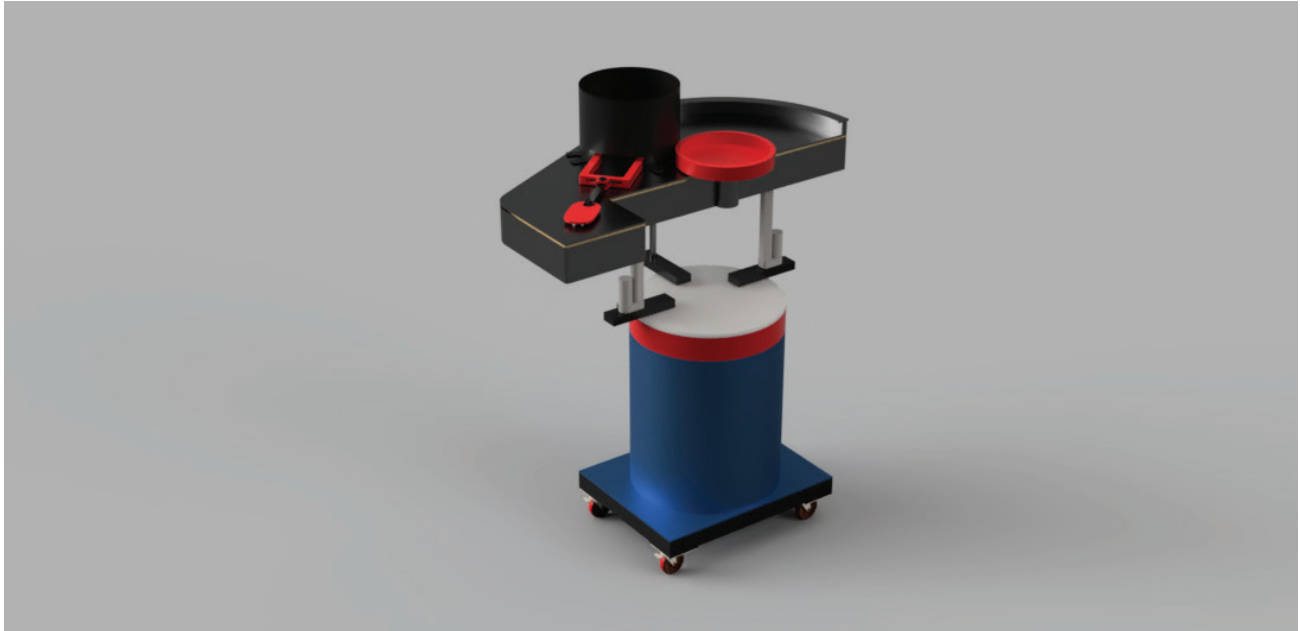
Team: Chris Hew, Zara Liu, Nicole Rix and Harsh Sinha

RoboSnake

The RoboSnake utilizes advanced articulated modules and integrated sensors to navigate and perform complex tasks in environments that are inaccessible or hazardous to humans.

Today's complex challenges across disaster response, infrastructure maintenance, and military operations require robotics that excel where humans face limitations. This project combines innovative research and engineering, focusing on enhancing safety and operational efficiency at an affordable cost across various industries.

The RoboSnake features a modular design, which is connected using innovative wrist joints, enabling it to mimic the biological movements of a snake and traverse narrow and complex spaces with unparalleled agility. Its advanced sensors and proprietary navigation algorithms enable real-time control while maneuvering through unstable terrains and obstructed pathways. In disaster recovery, it can enter collapsed structures to search for survivors and assess structural integrity. Within infrastructure maintenance, it offers a more feasible alternative to human inspections in confined or dangerous conditions, such as pipes or high-voltage environments. Additionally, its capabilities within military operations extend from low-level reconnaissance to possibly handling explosive devices, offering both strategic advantages and protection to personnel.

Our vision is to set new industry standards for robotic assistance in adverse conditions, making operations safer and more efficient. The RoboSnake is not just a tool; it is a next-generation solution designed to meet the growing need for access to and mobility within unknown and challenging environments. By enabling more reliable operations, the RoboSnake is poised to transform how we interact with and manage our physical world. As we move forward, we are committed to developing, manufacturing, and selling custom modular snake robots tailored to the diverse needs of our clients across the globe.

Team: Piers Bowater, Catherine Li, Nick Ntiruhungwa and William Yu

SAND-E

SAND-E is a robot designed to restore natural beach landscapes. Operable either remotely or autonomously, SAND-E is a low-cost solution for beach clean-up efforts.

According to the Marine Conservation Society, over 400 pieces of litter were found per 100 metres of sand during the 2020 Great British Beach Clean. Our mission is to tackle this pressing issue by introducing a state-of-the-art robot capable of filtering and collecting large amounts of small waste from sand.

Meet SAND-E: the Shoreline Area Navigator and Debris Extractor. SAND-E offers a cost-effective alternative to current beach cleaning machines, and serves to assist volunteers during clean-up efforts. Propelled by tracks, SAND-E can navigate even the toughest beach terrains, ensuring every inch of beach is spotless.

SAND-E employs an internal vibrating sieve mechanism coupled with a plough. The plough digs partially into the sand, lifting it along with any waste materials. The vibration of the sieve then filters out clean sand, returning it to the beach, and deposits unwanted debris into a collection bin.

Additionally, SAND-E uses an air blower to operate an air classification system. This system, located in front of the collection bin, makes sure that only lightweight waste such as plastics and cigarette butts are collected, while heavier materials such as pebbles are returned to the seashore. As a result, SAND-E is able to maintain the shoreline without compromising its natural landscape.

With growing concerns about plastic pollution and environmental damage, there is no better time than now to take this next step towards marine sustainability. From coast to coast, SAND-E is here to make waves in beach cleaning.

Team: Gabriel Bednarkiewicz, Joseph Lim, Fiachra O'Caoimh and Charlie Wright

TheLittleDotCo.

TheLittleDotCo. is a low-cost solution to producing braille on a wide variety of paper types, thick and thin. The desktop printer uses PLA extrusion technology to create small raises on the paper, differing from conventional indenting methods.

There are an estimated 43 million blind or visually impaired people in the world. Less than 10% of those, however, can read braille. With an estimated 750,000 people in the USA losing their sight every year, the ability to read braille is an ever-increasing issue. Braille literacy has a direct impact on employment. There is a 90% employment rate for those who can read, compared with a 35% employment rate for those who cannot. TheLittleDotCo. aims to solve this problem by providing low-cost printing services to allow for more children and adults to learn braille.

The printer has 3 key stages: a paper feeding mechanism, extrusion head and reheater. Repurposing an off the shelf paper feeding mechanism and combining with the extruder, the printer can reliably extrude small amounts of PLA onto the flat paper. Heating the paper to 50°C helps the polymer to bond to the paper, but the real strength comes in the reheat process: directed heat from an IR lamp melts the PLA, smoothing the dots and bonding them to the paper.

Aiming to improve access to braille resources, we will initially market this product to specialist schools and colleges within the UK. The wider TAM extends to over $335Mn.

Providing children and young adults with access to braille will increase the opportunities presented to them and improve their career aspirations, leading to higher employability and better quality of life.
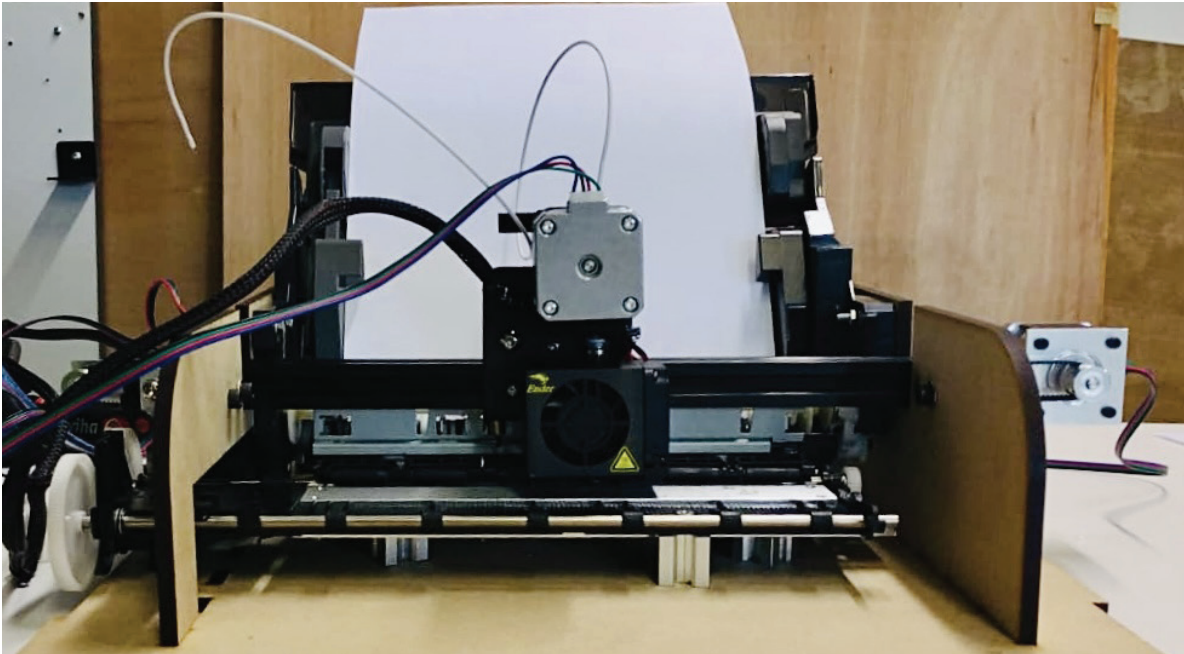
Team: Robert Chen, Matt Francis and Shan Patel

THE INSTITUTE FOR MANUFACTURING (IfM)

The Manufacturing Engineering Tripos (MET) is based within the University of Cambridge's Institute for Manufacturing (IfM), a division of the Department of Engineering. The IfM provides a unique environment for the creation of new ideas and approaches to modern industrial practice. It takes a distinctive, cross-disciplinary approach to global industrial issues, integrating research and education directly with practical application in industry.

The IfM brings together expertise in management, technology and policy to address the full spectrum of industrial issues. Research is undertaken in close collaboration with companies, ensuring its relevance to industrial needs. Industrialists contribute to our education programmes and host company-based projects, giving students experience of demanding, real-world problems.

The IfM's research findings are disseminated by the University-owned company IfM Engage. Experienced practitioners work with industry, governments and support agencies to apply research-based tools and techniques. This provides a rapid dissemination route for new ideas and helps to inform and fund future research.