

# Expanding Horizons with High Technology

TUM's lecture halls, labs and research internship programs inspire a steady stream of startup ideas. Here, we introduce three teams translating research findings into business ideas and embarking on their own ventures.



## IRUBIS

With sample carriers made of silicon instead of diamond, the IRUBIS team aims at making infrared spectroscopy faster and cheaper. Lorenz Sykora graduated in physics from TUM. His co-founders are physicist Anja Müller from the Technical University of Berlin and TUM business economics graduate Alexander Geißler (from left to right).



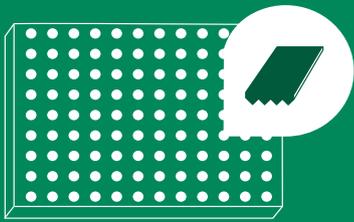
## Munevo

Munevo has developed a control solution for electric wheelchairs based on smart glasses. The Munevo team consists of TUM students and graduates Aashish Trivedi, Konstantin Madaus, Deepesh Pandey and Claudiu Leverenz (from left to right).



## retorio

With the help of artificial intelligence, retorio aims at helping users to improve their communication skills. Dr. Christoph Hohenberger and Patrick Oehler previously worked as PhD students at TUM's School of Management, while co-founder Abdurrahman Namli graduated from Istanbul Technical University (from left to right).



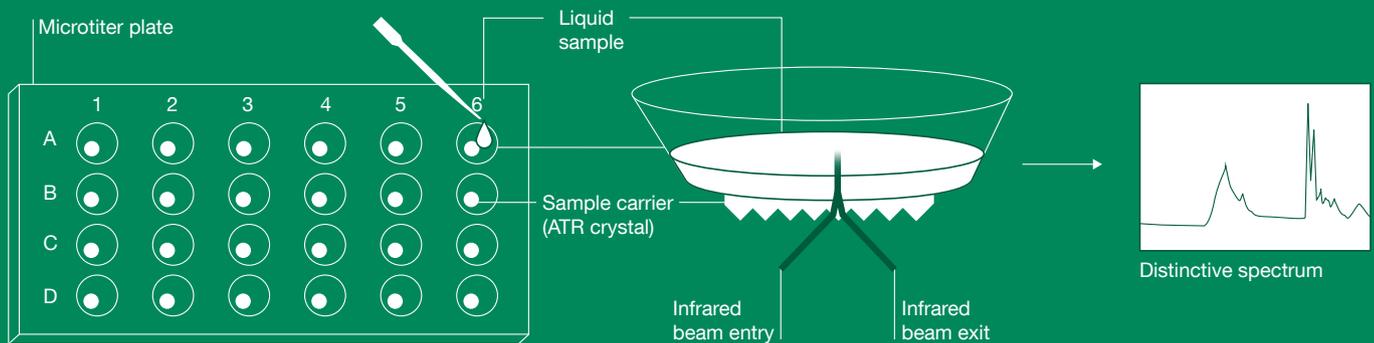
# Swift Sample Analysis

Infrared spectroscopy is an often time-consuming method for analyzing a wide variety of samples. With a cheap and disposable sample carrier made of silicon instead of diamond, IRUBIS aims to speed up this process.

**F**rom milk through motor oil to medication – just about every substance you can think of can be analyzed using infrared spectroscopy (IR). “This technique is standard practice at analytical laboratories,” confirms Lorenz Sykora, physicist and co-founder of IRUBIS.

The method involves passing infrared light through a sample, which causes the molecules inside to vibrate. Part of the light is absorbed, producing a spectrum. This spectrum is so distinctive that it can be used to pinpoint precisely which mole-

TUM, and fellow physicist Anja Müller, he developed new sample carriers made of silicon – the material used in microchips. “Our sample carriers deliver measurement results on a par with conventional carriers, at a fraction of the cost,” declares Geißler – now Managing Partner of IRUBIS. The single-use carriers enable up to 96 measurements simultaneously. “In the long term, we are aiming for production costs of less than a euro per unit,” adds Geißler. In 2017, the team received the TUM IdeAward for their business idea, which



The core component of the ATR (attenuated total reflectance) infrared spectroscopy technique is the crystal, which is used as a sample carrier and reflects the infrared light. The IRUBIS team has developed a low-cost silicon crystal with high sensitivity. Integrating many crystals into a well plate can make it possible to investigate up to 96 measurements simultaneously.

Infrared light is passed through a sample, causing the molecules inside to absorb part of the light and thus produce a spectrum.

The spectrum is so distinctive that it can be used to pinpoint precisely which molecules the sample is composed of.

cules the light has encountered. IR spectroscopy can thus reveal the exact composition of a substance. This can be used to detect impurities in milk, for instance, or to expose labeling fraud in medicines.

## Laborious manual cleaning

To date, however, performing several consecutive measurements has been a highly time-consuming task. This is due to the sample carriers, which are usually made of diamond and cost around 5,000 euros each. To justify this outlay, they need to be used many times over – which means manually cleaning the carriers after each measurement.

This is something Lorenz Sykora set out to change. Together with business economics graduate Alexander Geißler, whom he met at a business plan seminar hosted by Unternehmer-

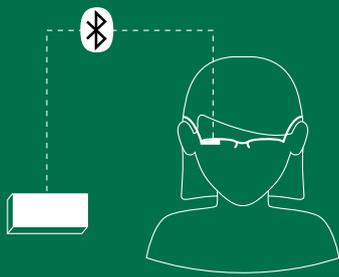
comes with 12,500 euros in prize money as well as individual consultancy services for their startup.

## Blood as the ultimate challenge

The silicon sample carriers fit all commercially available infrared spectrometers. Biotech companies are the first customers, keen to use IRUBIS' carriers for protein analysis as part of drug development. “In the future, we plan to enable blood analysis using our system too,” reveals Geißler. “But blood has thousands of different components – so that’s the master challenge of analytics.”

*Claudia Doyle*

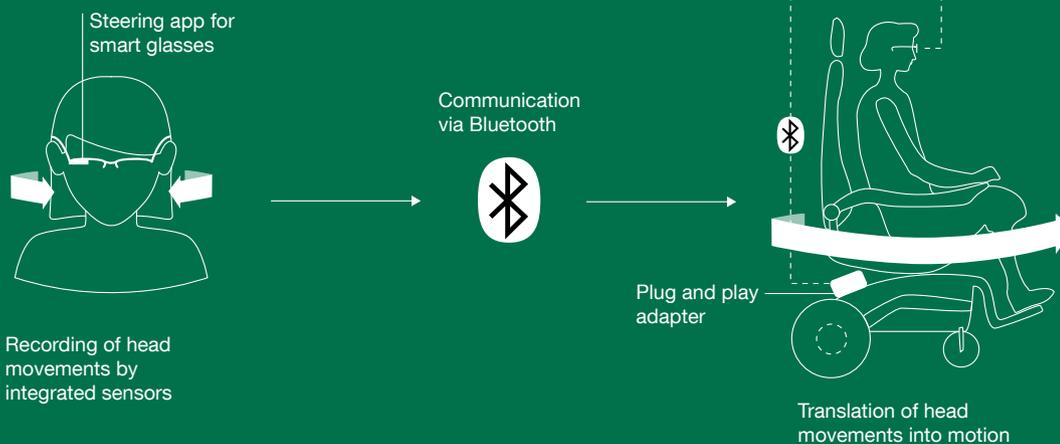
# Intuitive Wheelchair Control



The Munevo team has developed a smart glasses solution that enables people to steer their wheelchairs hands-free, just by using head movements.

First put on the glasses, then nod your head briefly, and the electric wheelchair begins to move. If you tilt your head to the right or left, the wheelchair turns in that direction. “The steering system is intuitive and adapts to the individual user,” outlines Claudiu Leverenz, who studied business informatics at TUM. Together with Konstantin Madaus, who holds a Master’s in Mechanical Engineering from the university, he founded Munevo to bring a new control system for electric wheelchairs to market. Currently, electric wheelchairs are usually steered with a joystick. People who cannot use their arms can steer with their chin or have sensors installed in the wheelchair’s headrest.

The idea originally stemmed from a research internship through Prof. Helmut Krcmar’s Chair of Information Systems in 2015, with Leverenz initially pursuing it as more of a part-time project. However, since 2017, he and Madaus have been focusing full time on Munevo, supported by informatics students Aashish Trivedi and Deepesh Pandey. Initially advancing their concept from TUM’s incubator with the added bonus of startup coaching, the team is now on the lookout for new premises.



Munevo’s control solution can be easily adapted to electric wheelchairs. It uses smart glasses to detect the wearer’s head movements. The data is sent via Bluetooth to a special adapter, which then translates this information into motion commands.

“These solutions do work, but our control solution based on smart glasses makes it easier to move smoothly,” explains Leverenz.

## Nod and off you go!

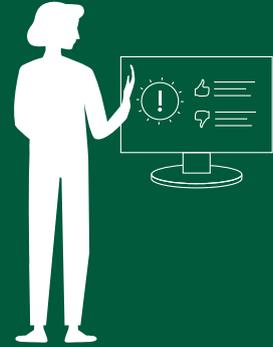
High-tech smart glasses are wearable computer glasses that integrate sensors. Using a software app developed by the Munevo team, these sensors can detect the wearer’s head movements and send the data via Bluetooth to a special adapter, which then translates this information into motion commands.

## Medical device approval pending

The invention is set to be approved as a medical device by the end of the year. A clinical trial is underway to demonstrate the safety and efficacy of the new control unit. “Here, subjects are using our system to navigate a wheelchair through an obstacle course,” discloses Leverenz. The amount of positive feedback he has already received from test users and medical supply stores keeps him motivated. “Our goal is to increase people’s independence and quality of life,” he confirms.

*Claudia Doyle*

# Virtual Communication Coach



At TUM, budding entrepreneurs benefit from the startup incubator on the Garching campus, which provides them with office space, workstations and coaching free of charge. The retorio team has made the most of this opportunity, developing a coaching program based on artificial intelligence.

It's a scenario most of us can relate to – standing by yourself in a packed auditorium, clutching a microphone with clammy hands and finding your mouth has gone dry. Performance anxiety affects many people when they give presentations and Patrick Oehler is no exception. “As a research associate, you often have to speak off the cuff in front of large numbers of people, and I suffered a lot from nerves at the start,” recalls Oehler who holds a Master’s in Management and Strategy and who until recently worked at Prof. Isabell Welpel’s Chair for Strategy and Organization at TUM. Together with his colleague, Dr. Christoph Hohenberger, and technical co-founder Abdurrahman Namli, they developed “retorio”. This software is intended to help people improve their communication skills and reduce their anxiety about public speaking.

### Training software to be responsive

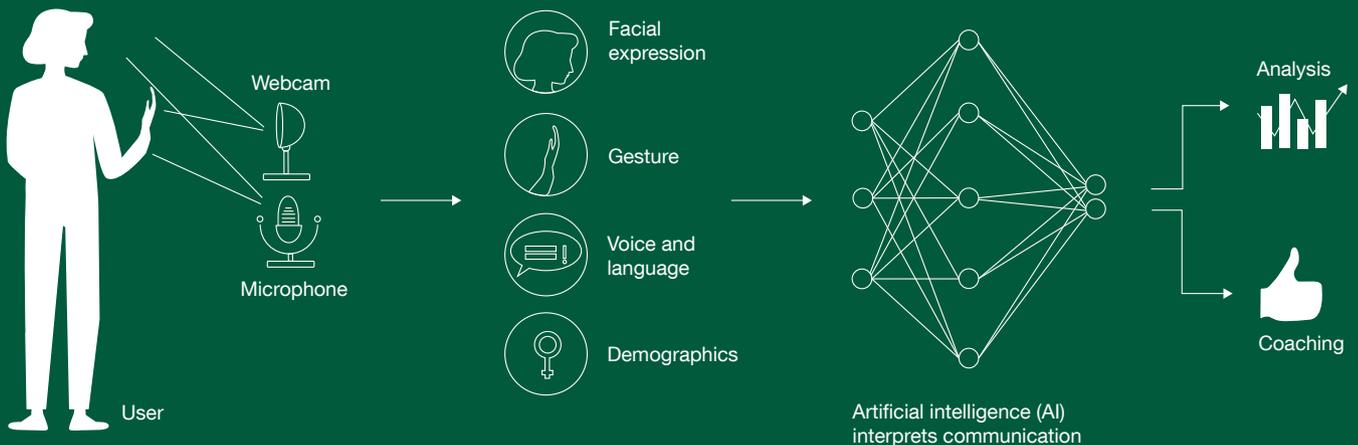
Artificial intelligence steps into the coach’s shoes here, filming a user’s presentation via webcam and analyzing their voice, facial expressions and gestures. It also provides the user with real-time feedback, for instance alerting them if they are speaking too fast. At the end of the presentation, it then gives a detailed evaluation of what is already going well and what the user still needs to improve.

For this feedback loop to work, the algorithm first has to be supplied with data. “Machines can already analyze voices, facial expressions and gestures,” explains computer scientist Namli, “but we have to teach them how other people respond to these elements and whether they find the presentation authentic.” The retorio team achieves this by drawing on a database of 10,000 videos, showing people speaking in a wide variety of contexts – from a mother describing her family to a young man giving a talk on cosmetics.

### Flanking human feedback

The retorio team asks participants to watch the videos and answer questions such as: “Would you like to work with this individual?” or “Would you trust this person?”. The algorithm derives patterns from this information and applies them to new situations. So the machine-based feedback for people using the virtual coach can become more and more accurate. The three company founders view their software as a valuable addition to human communications training. When it comes to market, users will be able to practice anytime, anywhere, from their own PCs. After all, as Oehler points out: “Many people are only really motivated to do this when a presentation is coming up soon.”

*Claudia Doyle*



**Anytime, anywhere coaching:** With retorio’s coaching software, users could soon practice presentations and get feedback at home on their PCs. The software is designed to record the presenter’s language, voice, facial expressions and gestures and uses artificial intelligence methods to analyze the data.