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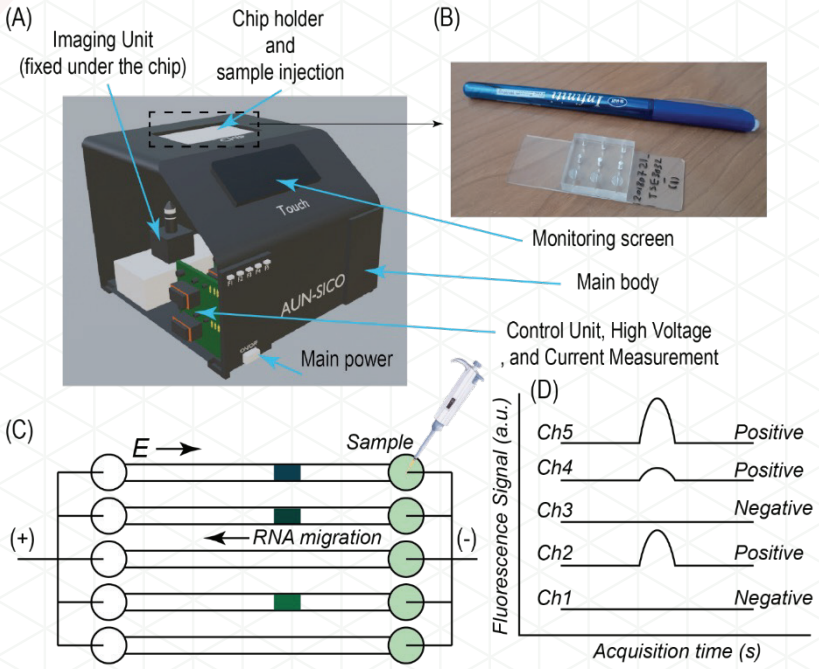
ICT R&D Newsletter in Egypt

Development of standalone device for improving the detection of viral infections for biological samples via automated microfluidic approach

Assiut University and E-SICO

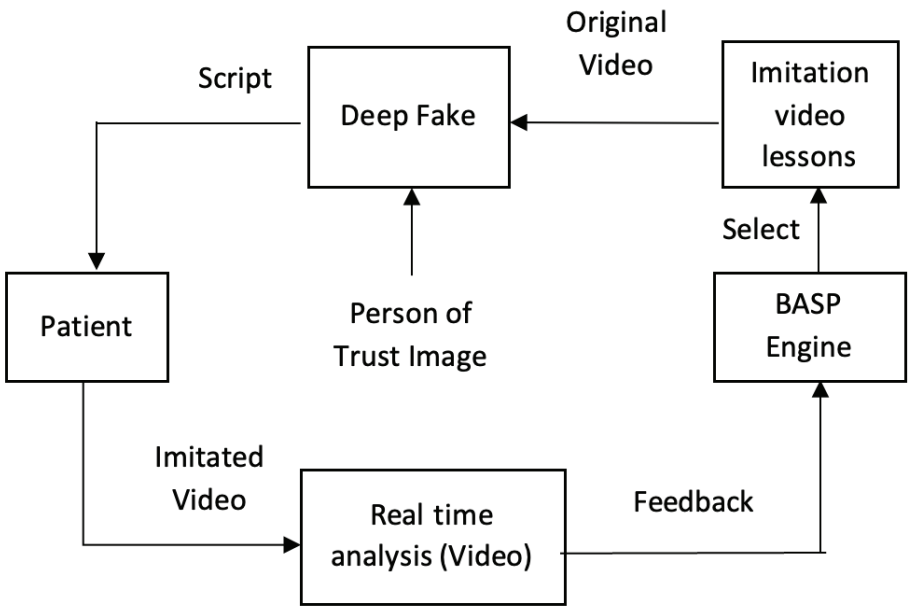
Researchers from Assiut University are developing a standalone device (Fig.A) for detecting of the viral infections in biological samples based on isotachophoresis (ITP) test on a microfluidic chip (Fig.B) in collaboration with E-SICO who are professionals in design of PCBs. Widely spreading viral diseases such as COVID-19 and viral hepatitis are crucial, and the early diagnosis should alleviate the severity of the disease. ITP phenomenon is an electro-focusing technique in which electromigration of target molecules (viruses), in an applied electrical field on discrete buffer condition, forms a concentrated ITP zone of the target molecules inside the microchannel (Fig.C). The pre-treated biological sample by adding the adequate probe for the target virus is used in the ITP experiment for detection the virus by measuring the fluorescence signal emitted from the formed ITP zone (Fig.D). The portable and standalone devices are key solutions for viral detection and health care in rural and far regions. They provide flexible, rapid, low cost, and reliable ways for early identifications of diseases. "ITP technique is a good alternative to the conventional PCR analysis especially when it comes to the simplicity, speed, and low cost of the test compared to PCR analysis' says Dr. Mahmoud N. Abdelmoez Assistant Professor at Assiut University and the project PI. They performed qualitative detections by executing negative and positive control experiments using buffer and DNA loaded samples, respectively. The records of the measured fluorescence signals during ITP experiments indicate higher signals of the infected samples compared to the negative ones.



Blockchain-Based Autism Services Platform (BASP

Arab Academy for Science and Technology and Maritime Transport

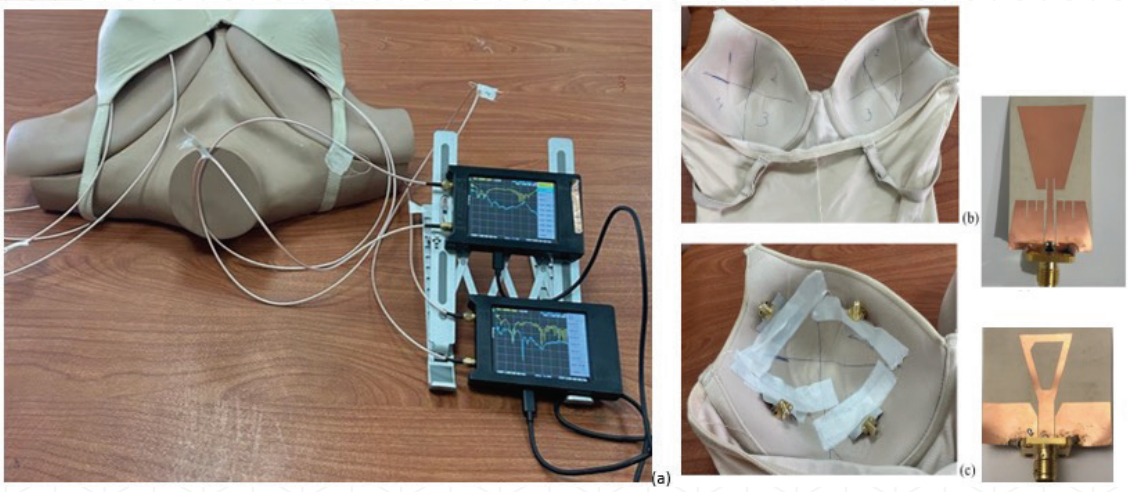
Researchers from Arab Academy for Science and Technology and Maritime Transport have developed a platform based on Blockchain technology. It provides a training service for autistic children. The multimedia provided by the platform will be based on person of trust like teachers, physicians or child mother introducing therapeutic/learning scripts in the form of video contents. By using Blockchain, the presented system securely protects child sensitive data alongside with the person of trust information. These recorded contents are presented as a set of video lessons, it is the imitation actions that are mimicked by autistic child for improving his skills. These lessons are manipulated first by deep fake in order to be appeared using any of person of trust. It overcomes the limitations for the current training programs that include challenges in real-world applicability due to reliance on high-end cameras or Kinect devices. On contrary to the proposed system that address these limitations, focusing on real-time techniques applicable in everyday settings. "The system allows autistic child to interact via the system through web application using a computer with single camera, without any special equipment that may not be available for all children. The proposed system was tested with several autistic children, and it demonstrated a strong level of interest and involvement in learning the lessons' Says Prof. Dr. Khaled Mahar Dean, Arab Center for Artificial Intelligence, Arab Academy for Science and Technology and Maritime Transport.



A Complete Breast Cancer Detection System using Microwave Imaging Sensors

Badr university in Cairo

Researchers from Badr University in Cairo developed a system in which integrates Microwave technology (MT) with machine learning, real-time imaging, and flexible monopole antennas, creating a portable, affordable breast cancer detection tool. Early, non-invasive, and accurate breast cancer detection is becoming increasingly important. MT offers a solution by leveraging the dielectric contrast between healthy and cancerous tissues, which differ in water content. Cancerous tissue has a higher water content, making it easier to detect with microwaves. MT is non-invasive, painless, and uses non-ionizing radiation, providing a safer alternative to traditional methods. MT sends microwave signals into breast tissue through antennas, which capture scattered waves to create an internal tissue image. This technology is particularly beneficial for women with dense breast tissue, where mammography is less effective. The high sensitivity of MT allows for early detection of tumors, even those that may not be visible through other imaging techniques. Additionally, the system's portability makes it ideal for resource-limited or rural settings, enabling use in mobile clinics and point-of-care diagnostics. By incorporating AI and machine learning, the system provides real-time feedback, allowing continuous breast tissue monitoring. "The project introduces a "Smart Bra' with 2×2 polarized elements capable of detecting tumors as small as 5 mm, with future designs for 4×4 elements targeting even smaller tumors. The system ensures safety with a specific absorption rate (SAR) of 0.75 W/kg. The study also explores how the number of sensors affects image quality and detection accuracy' says Dr. Dalia Elsheakh Professor, Electrical Department, Faculty of Engineering and Technology, Badr University in Cairo and project PI.



The Proposed Detection System

Optimization of Fuzzy Electric Vehicle Routing Problem

Nile university

Researches from Nile university has focused on the Electric Vehicle Routing Problem (EVRP), incorporating real-time variables like charging times and travel distances. The issue of sustainable development is global, with green innovation playing a key role in addressing environmental challenges, achieving carbon neutrality, and promoting sustainability. In Egypt, goods are distributed through a network of freight and logistics, which heavily relies on fossil fuels, contributing to pollution. To enhance sustainability, it is needed to replace high-emission trucks with electric vehicles (EVs). Optimizing freight routes is crucial to reducing distances traveled and minimizing environmental impact. The Vehicle Routing Problem addresses the logistical challenge of efficiently delivering products while considering customer demands and time windows. First, an innovative two-phase approach was developed for a real-time fuzzy EVRP optimization process. The fuzzy real time traffic conditions, namely congestion, were studied. To overcome the effect of recharging and congestion, a novel fuzzy real time adaptive optimizer (FRTAO) was proposed. It was tested on benchmark instances, and results showed that FRTAO improved the total cost. Then, environmental issues related to freight road transportation have been studied and suggests replacing conventional diesel vehicles with electric ones as a solution. Unfortunately, various challenges hinder EV adoption by transportation companies. “We have utilized PESTEL analysis (political, economic, social, technological, environmental, legal) and stakeholder questionnaires to explore the readiness of Egyptian transportation companies to electrify their fleets. It highlights both the opportunities and challenges involved in making this transition to address environmental concerns in Egypt’ says Dr. Mohamed. A. Wahby Shalaby is an associate professor in the Mechanical Engineering, Nile university and project PI.