TÜBİTAK UME's EFFORTS IN THE FIGHT AGAINST THE COVID-19 PANDEMIC

Being aware of its unique role as the highest national authority for measurements, and in line with policy and strategies defined by the government of Turkey, TÜBİTAK UME made several attempts to contribute to the global fight against the Covid-19 pandemic. New projects were predefined and launched after an intense evaluation that was carried out at an institutional level in close consultation with many stakeholders. The projects were chosen to take into account their potential to produce immediate impact within a relatively short period of time and availability of required resources.

As of April 2020, the following projects have been started to be carried out by TÜBİTAK UME within the scope of the fight against Covid-19:

- 2019-nCoV Virus RNA Reference Material Production for RT-qPCR Measurements
- Development of Thermal and Optical Based Systems for Detection of Pandemic Diseases
- Development of Optical Biosensors for COVID-19 Disease
- Development of Voltammetric Sensor and Device for COVID-19
- Virus Spread Reduction

A short summary of the objectives and activities of each project is presented below.

2019-nCoV Virus RNA Reference Material Production for RT-qPCR Measurements

RT-qPCR (Reverse Transcription Quantitative Polymerase Chain Reaction) method is one of the most efficient standard molecular diagnostic methods currently used for 2019-nCoV virus detection. On molecular based diagnostic systems, the analysis of 2019-nCoV virus starts with the reverse transcription (RT) of viral RNA to cDNA, and in the second step, cDNA is multiplied during qPCR when the most important step is the reverse transcription step and it should be strictly controlled. The objective of the project is the production of 2019-nCoV RNA reference material for use to control all steps of RT-qPCR. The RNA based Reference Material is highly demanded by testing laboratories and kit manufacturers for method validation, as well as for its use as an internal quality control material. In addition, 2019-nCoV RNA reference material will be used in proficiency testing schemes for external quality control purposes.

Development of Thermal and Optical Based Systems for Detection of Pandemic Diseases

The project is triggered by two main issues. Since fever is one of the main symptoms of Covid-19 diseases, the traceable and reliable measurements of body temperature became of utmost importance. That is why the first objective of the project is to set as the development of ergonomic and portable reference calibration sources for calibration of thermal cameras and forehead thermometers traceable to the ITS-90, and therefore ensuring the reliable use of devices for clinical purposes. The sources to be produced will cover the clinical temperature range, i.e. 25-40 °C. Algorithms to minimize the impact of external factors including the environmental conditions on the in-vivo temperature (fever) measurements of the human body by thermal cameras in-door and out-door areas will be developed as well.

The second issue to be addressed in the project concerns the development of techniques for the identification of viruses in the environment. The project aims to develop optical systems that detect nanometer-sized particles by label-free methods. Nanoparticles ranging from 10 nm to 500 nm (i.e. the sizes of common viruses and bacteria) will be detected in water using two independent methods, namely optical gradient force-detection method and interferometric method. In addition, the spectral properties of these particles will be analyzed by employing low-level luminescence spectroscopy methods.

Development of Optical Biosensors for COVID-19 Disease

Polymerase chain reaction (PCR) and some test kits based either on detection of proteins from the COVID-19 virus in respiratory samples (e.g. sputum, throat swab) or detection, in blood or serum, of human antibodies generated in response to infection are the current methods for the detection of SARS-CoV-2 virus. These techniques are quite effective, but some alternative techniques for fast detection of viruses are required based on the rapid spread of the virus. The main objective of the project is to improve a colorimetric (optic) sensing platform for the detection of SARS-CoV-2 virus in solution medium with a UV-Vis instrument and/or naked eye. In this way, it is targeted to obtain a fast, easy-to-use, selective and reliable detection method as an alternative to PCR and point-of-care testing.

Development of Voltammetric Sensor and Device for COVID-19

PCR and some antigen-antibody-based diagnostic kit methods are currently used for the detection of SARS-CoV-2. However, many alternatives to these techniques are under investigation. In this project, the voltammetry technique, in which the potential-current relationship is examined, will be used for the detection of SARS-CoV-2. Voltammetric detection of specific proteins of SARS-CoV and some other viruses by their isolated antibodies are available in the literature. For this purpose, the project will focus on the development, production and characterization of the voltammetric sensor for the detection of SARS-CoV-2, as well as the design, production and verification of the mini-sized device to perform the measurements. The sensor and device to be developed for the detection of specific proteins of the SARS-CoV-2 may become attractive globally. The project becomes prominent in terms of high accuracy and selectivity, the possibility of fast diagnosis, low cost of analysis, and because there is no need for experienced staff for performing measurements.

Virus Spread Reduction

The project aims to contribute to the reduction of the spread of the virus in society by making the required preventive measures. It is planned to inactivate viruses (i.e Covid-19, influenza, SARS, etc.) by heating and evaporating droplets and aerosols in the air and fomites, and therefore to reduce their transmission in the environment. It is planned to use infrared light for this purpose and to apply it in various public areas, e.g. emergency rooms, schools and public transport. Also, the use of microwaves to inactivate the virus spread in filters of air conditioning systems will be tested. The most efficient model for various applications will be determined depending on the wavelength, power, distance and area.