

	<i>Supervisor</i>	<i>Title</i>	<i>Description</i>
1	Dr. Abualseoud Hanani	Audio Classification	Audio classification is among the most in-demand speech processing projects. As deep learning focuses on building a network that resembles a human mind, sound recognition is also essential. While image classification has become much advanced and widespread, audio classification is still a relatively new concept. The mean idea of this project is to build a deep learning model that can accurately classify a given short duration sound (e.g. 10 seconds) into one of a predefined sound events such as music, human speech, vehicle, boom, crumpling, etc. Audio classification can be helpful in query based multimedia retrieval, acoustic scene analysis, and bio-diversity monitoring. For this project, we can work on Google AudioSet, which is a vast collection of labeled audio that they collected from YouTube videos. They all are 10-seconds long and are incredibly varied. We can use the audio files present in AudioSet to train and test our models. They are correctly labeled, so working with them is relatively more straightforward. There are currently 632 audio event classes and more than two million sound clips present in AudioSet (https://research.google.com/audioset/).
2	Dr. Abualseoud Hanani	Machine learning-based system for evaluating short stories understanding for Arabic speaking children	The main idea of this project is to develop a system that is able to evaluate the correctness of response of children (learners) for a given question upon a specific topic automatically. A set of carefully-selected multimedia prompts; text, picture, audio, or video describing specific topics, will be displayed to the child and then he/she is asked to answer specific questions upon what he/she has seen and heard in his/her language. The learner response represents how well he/she understands the topic and his/her ability to formulate the ideas and the strength in the language. All of these skills can be analyzed and evaluated by the proposed automatic system in terms of the meaning and maybe the language. In addition to the general evaluation, the system gives the child a feedback about his/her weakness and strengths. The proposed system is a multi-disciplinary system which uses different technology in computer science such as Natural Language Processing (NLP), speech processing and machine learning. All prompts and responses will be in Arabic language. To make it clearer, to encourage the child to go on, the prompts could be an Arabic learning story (displayed in a form of text or audio or pictures) which talks about a specific idea. It will be divided into parts and after each part it will display a question to the child upon what’s previously displayed to him/her. The child then is asked to answer the question from the story by speech in Arabic language to be evaluated to give a judgment of correct or incorrect answer.
3	Dr. Khader Mohammad	EEG brain scans model	EEG brain scans have been introduced as a way to detect emotions which opens doors beyond the medical field. Different techniques used in trying to classify Emotions (Boring, Calm, Horror, Funny) and authentication based on ECG signals. All sources of EEG Signal will be studied and analyzed from channel it was recorded in this research a Human emotions models based on EEG Signals will be build using python and other needed tools.
4	Dr. Khader Mohammad	A Hypered approach to verify ECG emotion extracted from ECG signal and face recognition.	In this project you will work into emotion generation from brain and classify the effect of environment conditions on EEG Signals that effect emotions and authentications. Will use face recognition to verify the matching. This is project is a continuation of previous project where emotion is extracted from brain ECG signal with 85% accuracy. What we need is to raise the accuracy % and compare to the face emotion recognin. We used python and machine learning to chive the goals.
5	Dr. Ahmad Alsadeh	Automatic Website Vulnerability Scanner Application	The purpose of this application is to build an automatic scanner for discovering, analyzing, testing, identifying, and reporting of website vulnerabilities of a target website.
6	Dr. Ahmad Alsadeh	IPv6 SEND Application for Mobile Devices	IPv6 SEcure Neighbor Discovery (SEND) is an extension to countermeasure the security threats in IPv6 Neighbor Discovery Protocol (NDP). SEND provides address ownership proof, message protection, and router authorization capabilities. The current lack of robust implementations of SEND at the end user devices limits its deployment and leave the door open for the attacks against NDP. The main goal of this project is to provide an open-source implementation of SEND for mobile devices.
7	Dr. Mohammed Hussein	CarPale Application: Buy-Sell New & Used Cars, Prices & Offers in Palestine	Today, finding a suitable car for your needs can be exhausting with a multitude of options available. This app will answer all your car related queries online.
8	Dr. Wael Hashlamoun	An Application-Based Wireless Controller of the University Heating System (Continued)	During the winter season, the engineering office at the university turns the heat ON and OFF by dispatching an employee to each building. This has to be done at least twice every day for each building. A group of students worked on this project in the previous semester and they achieved the following objectives <ul style="list-style-type: none"> • Built a mobile application that controls the heating in one building in the university. • Was able to turn the heating ON and OFF in that building based on a sensor and a feedback system • Designed and built an interfacing circuit, which receives the commands from the mobile devices and uses them to activate and deactivate the heating unit. The objective of this follow-up project is to build on the progress made by the previous group and carry out the implementation phase successfully. In particular, some of the outcomes of the project are: <ul style="list-style-type: none"> • Develop the mobile application to encompass multiple buildings, rather than just one. • Enable the engineering office to monitor the status of the heating systems in all buildings (possibly via a site). • Provide a historical log data base, where the important data is stored (such as the daily operation of the heaters, the weather temperature, the person responsible for the ON and OFF switching, and other useful data). • Carry out the design of the control and interfacing circuits for all buildings. • Run a practical test, with the aid of the engineering office, on one of the university buildings.
9	Dr. Mahran Quraan	Design and Control of Vienna Rectifier for DC Motor Drive	The VIENNA rectifier can be used to improve the power factor of a three-phase rectifier. The project aims to design and control of an AC-DC conversion system to produce a three-phase, three-level unity power factor rectifier such that the converter draws high quality sinusoidal supply currents and maintains good DC link voltage regulation under wide load variation. The output of the rectifier is used to feed the input of DC-DC converter for the control of DC motor. The final report is supposed to have some simulation and experimental results on a prototype to confirm the feasibility of the machine drive system.
10	Dr. Mohammad Jubran	Mobiclink	Mobiclinic integrates several medical examination tools and exercises in an easy-to-use mobile application. In this project, we will focus on physical therapy for the shoulders. The shoulders consist of several joints and have the most range of motion of all our body joints. Thus shoulder pain and injuries are very common. Physiotherapists examine and treat patients through several sessions. As part of the treatment plan, the patients need to do specific exercises at home. Proper and accurate implementation of these exercises is very important for quick and healthy healing. This project consists of two dashboards; a management dashboard for physiotherapists and a patient dashboard for the patient. Each of these dashboards will consist of several components including the treatment plan, treatment progress status, and session scheduling and payments. Another very important feature of this application is to use the mobile sensors and/or camera to allow follow-up and supervision for treatment exercises by the Physiotherapist. For the implementation of this feature, we will build a dataset and use deep-learning techniques.
11	Dr. Abdalkarim Awad	Oxygen Concentrator for Ventilator Machine	The main goal of this project is improving the design of a ventilator and adding oxygen concentrator. The students have to search for different ways to have concentrated oxygen and implement one of the approaches. Additionally, student have to improve the operation of an already implemented ventilator. Furthermore, the students have to build an android APP to remotely monitor the patients connected to a ventilator.
12	Dr. Muhammad Abu-Khaizaran	Active Voltage Control for Series Connected GaN HEMTs	The objective of this project is to design and implement a High Voltage/Power switch using Series connection of GaN HEMTs. In particular, the Active Voltage Controller method will be used in seriesing GaN HEMTs. Voltage sharing between series devices will be studied. The study includes designing, modeling and simulation gate drives for series/parallel techniques in Simulink/MatLab or other simulation packages. A prototype High Voltage/power switch implementing series/parallel technique will be constructed and tested to demonstrate the sharing of voltage experimentally.
13	Dr. Muhammad Abu-Khaizaran	A GaN HEMT Based Voltage Source Inverter	The objective of this project is to design and implement a new power electronic device; GaN HEMT in the typical Voltage Source Inverter (VSI). In particular, the effect of implementing the GaN HEMTs on the VSI’s efficiency and performance will be studied, compared with those of VSIs implementing MOSFETs or IGBTs. The study includes designing, modeling and simulation of the inverter in Simulink/MatLab or other simulation packages. A prototype VSI implementing GaN HEMTs will be constructed and tested experimentally to demonstrate the attractive features of VSI gained.
14	Mr. Mohammad Al Ju'Beh	Design of plant growing and monitoring system	Design and implement a system to grow and monitor a specific plant. The system contains different sensors such temperature sensor, ph sensor, light sensor, water level sensor, and camera The system contains different actuators such as water pump, nutrient dispenser, grow lights, and ph regulator The brain of the system is a controller that collects the data from the sensors and perform the required actions. The collected data will be displayed on a screen and to be sent to the user.
15	Mr. Mohammad Al Ju'Beh	Design of baby incubator	Design and implement a baby incubator to provide the premature infants the best environment for their developments and continual monitoring The system contains different sensors and actuators The vitals monitoring sensors must be able to detect temperature, heart rate, and weight of the infants The incubator might include special lights to help reduce jaundice The brain of the system is a controller that regulate the temperature inside the incubator
16	Dr. Ashraf Al-Rimawi	Doctor AI	Continuous monitoring of diabetic patients improves their quality of life. The use of multiple technologies such as the Internet of Things (IoT), embedded systems, communication technologies, artificial intelligence, and smart devices can reduce the economic costs of the healthcare system. For this reason, we propose Doctor AI which will help patients with chronic diabetes manage their blood glucose levels in their target range, and also can assist in providing a healthier lifestyle for patients through activity and diet tracking. Doctor AI will propose a patient monitoring system based on Internet of Things (IoT) and a diagnostic prediction tool for diabetic patients. This system provides real-time blood glucose readings and information on blood glucose levels. It monitors blood glucose levels at regular intervals. Accordingly, it aims to prevent high blood sugar and significant glucose fluctuations and control on it. Doctor AI will provide a precise result where, the collected and stored data will be classified by using several classification algorithms to predict glucose levels in diabetic patients.
17	Dr. Ali Abdo	Vehicles Speed Measurements and ABS in Vehicles	
18	Dr. Ali Abdo	Design and Implementation of Blind Juggler Robot	
19	Dr. Wasel Ghanem	Developing of an innovative System to Determine Eco-Path in Automobile Driving.	It is expected to develop different algorithms using machine learning to detect best route that saves fuel consumption and reduces the amount of CO2 that comes out to the environment. Moreover, due to driver behavior while driving, a proposed model for maintenance of different mechanical parts in the automobile in earlier stages will be suggested. The Development should be based on an App “Carbin” developed in cooperation between Birzeit and MIT.
20	Dr. Wasel Ghanem	Intelligent Drone System	In this project, it is expected to develop an intelligent system using machine learning and AI based on Drone platform. It is proposed to capture different images from different heights and then analyze these images to recognize different objects like humans, trees, buildings, etc. Moreover, the Drone system could work as mobile weather station by measuring temperature, pressure, wind direction etc. in different heights.
21	Dr. Abdallatif Abuissa	A Mobile Application to Support Health Issues for Elderly	In this project, the students will develop a mobile application that supports the medical needs of old people. The students will be provided with a wearable computer that can take some information about the person, in addition to all history of the person to provide recommendations/reminders to him/her. More features can be added.
22	Dr. Abdallatif Abuissa	A Mobile Application for Kids Follow-Up	In this project, the student will develop a mobile application that can be used by the parents to follow up the place of their kids. The application will provide information about the place of their kids and the time they spent their. Also, it will give alarm to the parents if their kids enter some area, or leave some area. More features can be added.

23	Dr. Jaser Sa'ed	Protection coordination for highly photovoltaic-integrated power systems	In the recent years, with the concept of Smart Grids, there are a great interest in integration of photovoltaic (PV) units at distribution level. Along with a number of benefits, penetration of PV units in the distribution system imposes some serious challenges; protection requirements turns up as one of the most critical challenge in PV integration. In this project, the possibility of occurring mis-coordination between protection devices in distribution network will be addressed. On the other hand, there are several mitigation techniques used to solve the mis-coordination problem; a study of these technologies will be conducted and a suitable technique will be designed and implemented.
24	Mr. Nasser Ismail	Effect of choice of azimuth and tilt angles PV system Performance	The PV system performance is affected by many parameters, among which are the azimuth and tilt angles. This project will focus on comparison of theoretical, simulation and practical results from PV systems implemented in Birzeit University Campus. Prerequisite Courses: ENEE5307 and ENEE4202
25	Mr. Nasser Ismail	A Study of Key Modern Electric Vehicle (EV) Components, Technologies, Challenges, Impacts, and Future Direction of Development	This project will focus on reviewing all the useful data available on EV configurations, battery energy sources, electrical machines, charging techniques, optimization techniques, impacts, trends, and possible directions of future developments. Its objective is to provide an overall picture of the current EV technology. Simulations and Calculations of key components of EV will be performed. Prerequisite Courses: ENEE5303 and ENEE5307
26	Dr. Ismail Khater	Arabic Sentiment Analysis	Sentiment analysis uses Arabic text analytics, which combines natural language processing with machine/deep learning approaches for building classification models and estimating sentiment scores. The project's aim is to build a model for sentiment analysis using an annotated list of positive and negative sentiment words in Arabic and a pre-trained word embedding. The project consists of two phases. Phase one might require building an Arabic dataset/corpus. Also, if we can find a publically available dataset, we will just use it. Phase 2 trains a machine learning classifier to estimate sentiment scores
27	Dr. Ismail Khater	Object Classification Using Deep Learning with Raspberry Pi	This project is aiming to deploy a deep learning algorithm (e.g., ResNet-50) onto a Raspberry Pi. We will build real-world computer vision applications (e.g., Object classification and recognition) and perform inference tasks on embedded hardware.
28	Mr. Aziz Qaroush	Content-Based Video Indexing and Retrieval: A summarization-based approach	Video summarization is the process of synthesizing an arbitrary video into an abstract, shorter, and understandable representation. Video summaries can generally be split into two main categories, namely dynamic and static summaries. Static summaries are formed from a set of images representing key events called keyframes, which also convey the video's temporal evolution. Static summaries are less entertaining than their dynamic counterparts as they are limited to still images. However, they introduce a more practical approach when extending video summarization to an applied video management and indexing solution. In this project, we will do video indexing based of the keyframes resulted form video summarization. Video indexing is the process of providing watchers a way to access and navigate contents easily; similar to book indexing. The selection of indexes derived from the content of the video to help organize video data and metadata that represents the original video stream. In this project, we will do video indexing based on the keyframes resulted from the video summarization stage.
29	Mr. Aziz Qaroush	Electronic Platform for Shopping and Deal-hunting.	These days' humans live with great technological development, where this progress is reflected in all aspects of life. One of these areas is a great trend towards using electronic delivery companies and electronic stores as well. So, our goal in this project is to develop an electronic platform and mobile application that combines electronic shopping and deal-hunting. It allows stores to provide their products. Also, its searches for the best matches of the user's needs. The application will be for household electrical appliances.
30	Dr. Hakam Shehadeh	Optimal Segmentation of BZU MICROGRID	A strategy to design microgrids with distributed generators consists of taking advantage of an existing distribution network (BZU microgrid) by sectoring the system into a set of microgrids with optimal autonomy. This project will deal with BZU microgrid and will look for a methodology for the optimal design of microgrids based on the virtual segmentation of a distribution system. it focuses on the optimal allocation and sizing of the distributed generation together with the determination of the virtual cut-set lines to form an optimized set of microgrids.
31	Dr. Hanna Bullata	Perception-to-action: Visually guiding a robot gripper to grab objects using openCV library under ROS operating system	Robotic arms (manipulators) end up with grippers, similar to human hands. These grippers are supposed to grab objects and move them around. Before grabbing these objects, they have to be well identified to make sure the gripper is grabbing the right object. The objects the gripper is supposed to handle are library books. Students are required to make use of a camera and a distance sensor in this project, among other sensors. The camera should be able to identify book boundaries on shelves using the openCV library. Then, using the distance sensor, the camera will be located appropriately in order to identify book titles. The images will be processed to extract text. Once the correct book title has been identified, the coordination perception-action must take place until the book is grabbed and put in a box. You need to build a simulated environment under ROS for a robotic manipulator attached to a fixed base in order to prove the concepts in ideal situations. Students should be familiar with Linux OS (mainly Ubuntu) or willing to learn quickly.
32	Dr. Adnan Yahya	Quality and Recency Assessment of Web Content and Social Media Posts	General Area: Information Retrieval and Web Search. Arabic Natural Language Processing. Project Description: In the age of Big Data, digital content is growing fast without strict quality controls. It is natural for many to go first to the Web for their knowledge needs. The democratization of the Web when everybody can add own content without supervision, makes content quality a big issue. It is necessary to account for quality factors when returning documents in response to a user query. Current search engines try to do that but not adequately. One parameter of quality is recency: having the content adequately updated to reflect recent changes on the subject matter. This may be very important for news items, biographies, institutional and corporate sites and more. We would like to have assurances that the content is trustworthy and of good quality and is being current. The issue has been a topic of work in the scientific community, mostly for content in other languages, and it is of interest to look at the issue for Arabic. In the project we plan to study approaches to assess article quality, recency of Arabic web content. The project will involve getting to work with popular machine learning tools and systems (open source) available, like WEKA for experimentation/testing. The hope is that the results will be publishable material. Prerequisite knowledge/skills: The usual: Basic programming (Java is a plus!), some probability and statistics and Artificial Intelligence and interest in dealing with Web Content and Machine learning. Possible Reading: (Book): Manning, Schuetze and Raghavan: Introduction to Information Retrieval. http://nlp.stanford.edu/IR-book/ (Article): Stvilia, Twidale, Smith and Gasser. Assessing Information Quality of a Community-Based Encyclopedia. http://mailer.fsu.edu/~bstvilia/papers/quantWiki.pdf (Tools:WEKA): http://www.cs.waikato.ac.nz/ml/index.html (Tools:Mallet): http://mallet.cs.umass.edu
33	Dr. Adnan Yahya	Named Entity Disambiguation in Search Results in Arabic and English	General Area: Big Data, Information Retrieval, Web Search, Text Classification, Named Entity Recognition. Short Project Summary: How to classify the search results returned by a search engine to disambiguate the main named entities in terms of parameters like topic, location and more. Project Description: In search results one could have information about multiple entities lumped together because these entities share the same name. As an Example you can have Jackson the Politician, the Artist and the Scientist/Physician. The search results on “Jackson” will lump all the pages relevant to any of these entities together while the user may be interested in one of them only. We would like to use the initial search results (full text or Abstract or “snippets” to help disambiguate the multiple entities lumped together by classifying them into several classes and asking the user if interested in a particular instance of the entity. For our example we may ask the user to select from the 3 Jacksons and return only the corresponding results. We will have to measure the success rate and the tools used and attempt to integrate that as an add-on to functional search engines. Prerequisite knowledge/skills: Basic programming (Java is a plus!), probability and statistics and Artificial Intelligence; interest in Web Content and Search/Information Retrieval. Possible Reading: (Book): Manning, Schuetze and Raghavan. Introduction to Information Retrieval. http://nlp.stanford.edu/IR-book/ Hao Chen and Suzan Domias; Bringing Order to the Web: Automatically Categorizing Search Results http://research.microsoft.com/en-us/um/people/sdumais/chi00.pdf Zheng Zhu; Improving Search Engines via Classification https://www.dcs.bbk.ac.uk/site/assets/files/1025/zheng.pdf Agustin Delgado, Raquel Martinez, Victor Fresno and Soto Montalvo A Data Driven Approach for Person Name Disambiguation in Web Search Results http://www.aclweb.org/anthology/C14-1030 Dmitri V. Kalashnikov Sharad Mehrotra Zhaoqi Chen Rabia Nuray-Turan and Naveen Ashish, Disambiguation Algorithm for People Search on the Web http://www.ics.uci.edu/~dvk/pub/ICDE07_dvk.pd
34	Dr. Adnan Yahya	Meta E-Commerce System with Payment and Delivery	General Area: Web Design, Payment System, Mobile App Design and Tools, Front/Back end design, Web site aggregations. 3-line Project Summary: Build a Meta e-commerce system that can integrate data from various sources, allows the user to make purchases from a group of merchants and through a single point, and allow merchants to integrate their own point of sale with other sources of merchandise orders. Emphasis is placed on system security, payment component, interaction between users and providers, work flow in the merchants system, user feedback, product delivery and tracking options. Project Description: The project envisions the design of a system: a portal and mobile app for a sophisticated meta e- Commerce System to handle operations like: 1- User registration and profiling 2- Integration of data from multiple sources for single point access to multiple sellers. 3- Communication with clients point of sale and work flow system 4- User feedback and communication between sellers and buyers. 5- Integrated Product delivery and vehicle routing for cost effective delivery and in time confirmation of delivery status. The Project will not start from scratch: the implementation will be based on reusing readily accessible open source components and tools and integrating them into a workable system. Prerequisite knowledge/skills: Basic programming , Interest in Web and mobile App design, product development. Possible Reading Material: 1- Zheng Qin Han Yi Li Shundong Dong Jinchun Yan Lixiang Qin Jun. “E-commerce Architecture and System Design”. https://link.springer.com/chapter/10.1007%2F978-3-540-49645-8_8 2- How to Design an E-Commerce Website: From Homepage to Checkout. https://snipcart.com/ecommerce-website-design 3- Wei and Zhang. Design and Implementation of Online Shopping System Based on B/S Model https://www.researchgate.net/publication/329472221_Design_and_Implementation_of_Online_Shopping_System_Based_on_BS_Model 4- 17+ Best Ecommerce Platforms Reviewed and Compared (2021) https://www.adamenfroy.com/ecommerce-platforms 5- https://www.deliverect.com/us 6- Building Online Stores. https://www.websitebuilderexpert.com/building-online-stores/ 7- Vatrapu, Sidhartha Reddy, "Design and Implementation of E-Commerce Site for Online Shopping" (2014).All Capstone Projects. 79. http://opus.govst.edu/capstones/79 8- Best Ecommerce Platforms https://www.investopedia.com/best-ecommerce-platforms-5092528

35	Dr. Ayman Hroub	E-Government Services Platform	<p>In this project, the students are expected to develop a web-based platform that automates the governmental services, such that the citizens and the residents of a country can benefit from these services with minimal personal presence to the governmental departments. The user can access this platform through either a web browser or a mobile application. Thus, the students are expected to develop a mobile application for this platform.</p> <p>The platform enables the user to create an account with a unique identity, view the status of his or her governmental documents and services, pay/refund fees and fines, apply for different governmental services, receive notifications/ reminders on the mobile application whenever an action is performed on the account, or when any of the documents is about to expire.</p> <p>This platform comprises multiple modules. For example but not limited to,</p> <ol style="list-style-type: none">1. ePassport, which contains the passport information, entry visas, travel history, etc.2. Vehicle services, which includes vehicles' information, driving license, accidents' records, traffic fines, car insurance, etc.3. National medical record, which includes the health status and the history of infections, vaccinations, diseases, medicines, LAB tests, doctors' visits, medical images, medical reports, etc. <p>Prerequisites: the students should have experience in (or willing to learn) mobile application development, Java and web design technologies.</p>
36	Dr. Ayman Hroub	Mobile Application Controlled Smart Prepaid Utility Metering System	<p>This project aims at allowing the customer to control and monitor his or her account(s) on the smart prepaid utility (e.g., electricity) metering system through a mobile application. The application is supposed to communicate with the utility's server side through APIs (Application Programming Interfaces). This will enable the client to:</p> <ol style="list-style-type: none">1. Charge his or her account. Thus, system should provide payment methods.2. Get notified when the balance is too low or when the rate changes.3. Get notified when there is a tampering attempt of the meter.4. Visualize consumption history data and forecast the future consumption.5. View other details, such as, rate, bills, current balance, etc.6. Report an issue to the utility provider <p>Prerequisites: the students should have experience in (or willing to learn) mobile application development, Java, APIs, and smart prepaid utility metering.</p>
37	Dr. Jamal Seyam	A Centralized Measurement, Data Collection, and Analysis System Solution for Birzeit University Campus Microgrid.	<p>Renewable energy systems using solar PV devices has been regularly used in different homes and institution sites in Palestine. Recently Birzeit University campus microgrid has been upgraded with the introduction of several PV-energy systems. These systems where installed in different sites at the university. However, a centralized measurement system that collects and analyzes data from a set of these sites or the total PV-installed system does not exist. This project aims to:</p> <ul style="list-style-type: none"><input type="checkbox"/> Study and analyze the actual recent status of the BZU microgrid PV-system.<input type="checkbox"/> Generate electric and site maps of BZU microgrid PV-system.<input type="checkbox"/> Propose a centralized measurement, data collection, and data analysis of the microgrid PV-system.
38	Dr. Jamal Seyam	Design of an Automatic Vein-Detection and Intravenous IV-Cannula Insertion System for Medical Applications.	<p>Several medical applications such as blood withdrawal, medication intravenous injection, and fluids infusion require the insertion of a cannula in defined vein sites. Non-Expert operators may miss veins and causes harm to patients. This project aims to design a system that can automatically detect veins in a specified body site and guides the insertion of the needle of the cannula, which can be used in following medical management activities.</p>