KADDB Suggested Projects 2019

No.	Category	Topic	Description	Expected Deliverables
1	**Electrical Systems**	**Laser Warning Receiver**	In this projects, a laser warning system LWR will be designed, implemented and tested. Laser-guided weapons generally consider a laser designator operating at a 1064 nanometer (+/- 2 nm) wavelength. The designator's optics will have a low divergence, with most under 300 micro radians. Hence, the laser beam's effective area is about 1 meter square (or smaller) at a range of 3 kilometers. The laser's pulse width is around 15 to 25 nanoseconds with a pulse energy of about 50 to 120 millijoules. The use of very narrow pulses means the peak output optical power is actually several thousand watts. The laser designator illuminates the intended target and the bomb/ missile seeker "flies" into the reflected energy. There can be up to 30 seconds from the time the laser is activated to the impact of the bomb/missile. The laser designator and the bomb/missile seeker head need to both be pointing towards the target before launch. A laser "back scatter" condition can exist where sand/dust/etc. in the air causes a false lock before the bomb/missile is launched. The project will implement a laser warning receiver for wide range of frequencies ranging from 700nm—1550nm and wide aperture area of the receiver that can capture signals from wide range of angles.	1-A laser warning receiver circuit that can detect different military laser signals and issue proper warning 2-PCB and schematic designs for the laser warning receiver circuit 3- All related design documents.
2		**Audio transmission using laser signals over free space**	In this project, we target the implementation of a testbed that can be used for many future developments. We will design and implement a free-space optical communication FSO system with transmitting and receiving nodes communicating over free space at high data rate. Communicating nodes can transmit information over different frequencies and we will be targeting different laser frequencies. The Goal is to establish a FSO link that is capable of transmitting Audio, video and text messages.	1- A FSO link designed and tested that is capable of transmitting suede messages over wide Range of distances and at high data rates. 2- Complete schematic and PCB designs for the designed FSO system 3- A FSO testbed that can be used for future development. 4- All related design documents.

KADDB Suggested Projects 2019

No.	Category	Topic	Description	Expected Deliverables
3	**Electrical Systems**	**Solar Powered Forest Fire Detection and Control System**	The idea of implementing this project is to detect and prevent the forest fire remotely by using a ZigBee communication. The entire transmitter circuit is located in forest with different sensors like smoke and fire detectors, which are powered with solar-panel system. The embedded circuitry in the transmitter circuit collects data and sends it to a remote PC through the ZigBee communication module. On the receiver side, a ZigBee-transceiver-based PC receives these signals, correspondingly alerts the fire engines, and actuates the fire protecting equipment in the forest remotely.	1-A functional prototype consist of receiving and control circuit, the communication system needed sensors and actuators, and an appropriate PC based monitoring ZigBee-transceiver. 2-All related design documents. 3-To operate the system on the KADDB's research section's lab. Computer.
4	**Robotics & Mechatronics Systems**	**Underwater robots- also known as remotely operated underwater vehicles (ROV) with Video Monitoring and Object tracking system (phase 2)**	A remotely operated underwater vehicle (ROV) is tethered underwater mobile device. ROVs are unoccupied, highly maneuverable, and wired operated by a crew on ground. They are common in deep-water industries such as offshore hydrocarbon extraction. In phase I a body frame from polyethylene material was made, also electrical components was integrated such as (DC/AC convertors, DC motor drives, waterproof camera, etc.…). In addition, the control system was implemented using (Raspberry Pi 3, PixHawk and other interfacing units), in other words a base platform for more advance tracking system was made. In phase II, an object tracking and recognition video system to be designed and integrated with the existing ROV.	1-All related design documents. 2-All related codes and libraries built in KADDB's research section lab. Computer. 3-An appropriate GUI for video monitoring and object tracking. 
5		**Infrastructure less communication for border monitoring and security (phase 2)**	In phase I, the aim was designing and implementing an infrastructure less communication network nodes built on a small size UGV and UAV which would be used for sensing and monitoring in remote areas, that is a prime importance for many security related applications and scenarios. The aim in phase II is to develop the system's elements such as a bigger size UGV equipped with needed sensors and actuators, reliability, durability and range. 	1-All related design documents. 2-All related codes and libraries built in KADDB's research section lab. Computer. 3-A functional UGV prototype equipped with all related sensors and actuator. 4-KADDB will provide the small multirotor UAV for testing issues.

KADDB Suggested Projects 2019

No.	Category	Topic	Description	Expected Deliverables
6	**Robotics & Mechatronics Systems**	**Autopilot for Fixed Wing Plane (phase 2)**	This project aims to design and implement a flight controller for a fixed wing plane. This will be achieved in more than one phase. In phase 1, common understanding of the system's architecture. This was achieved by integrating and understanding the functions of the ready-made H/W, software libraries and algorithms based on ROS and Linux on board mini PC. In the second phase, the goal is to develop the existing codes and algorithms such as stability, take off, landing, and navigation. The fixed wing plane shall have the capability to fly through predefined points also, Take off will be controlled to be stable and smooth, as well as landing. Various control algorithms and navigation sensors will be used in order to come up with the optimum combination.	1-Understanding the existing system's algorithms from phase 1 2-Finding the existing UAV mathematical model Writing your own stability, take off, landing and navigation algorithms. 3-All related design documents. 4-All related codes and libraries built in KADDB's research section lab. Computer.
7		**Electric Unmanned Ground Vehicle (phase 2)**	In phase I a 1-seater gas motor powered, all-terrain vehicle converted to a EUGV capable of teleoperation and live video streaming. The system was implemented using Arduino as the control unit and XBEE as the communication system, also VFD motor drives had been selected from ABB and the EUGV is power by a LI-ION batteries. In phase I is a base for more advanced functionality, such as autonomous navigation, obstacle avoidance, terrain mapping and advanced surveillance, which will be implemented in the second phase by using the proper hardware and robotic operating system (ROS). 	1-All related design documents. 2-All related codes and libraries built in KADDB's research section lab Computer. 3-Design and implementation of autonomous control system 4-Selection of all needed system's units and elements such as sensors, and communication system other than XBEE. 5-A functional prototype built on the existing EUGV.

KADDB Suggested Projects 2019

No.	Category	Topic	Description	Expected Deliverables
8	Mechanical Systems	**The impact of welding on the Armor plates.**	Armor plates are being used in military applications for protection purposes. Armor plates come with different thickness and passes through different thermal and mechanical processes such as heat treatment. However, throughout the assembling process, these plates are exposed to high temperature due to welding process, which leads to change the mechanical properties precisely at the welding areas.	1-The consequences of using different welding techniques to assemble the armored structure. 2-Study the heat effected zone generated by the welding. 3-Recommend solutions to mitigate or solve this issue
9		**Synthesizing a steering system for a medium weight vehicle**	All steering systems contain several common parts, and every system, no matter what type, will have a steering wheel, a steering shaft and column, a flexible coupler, universal joints, and tie rod. This system contributes significantly in vehicle handling and allow the driver to guide the vehicle.	Design a steering system for a lightweight or medium weight vehicle.
10		**Armored Vehicle Engine Compartment / Thermal Management System**	The engine compartment in armored vehicles represents almost an isolated zone since it is typical protected from all side. Nevertheless, it has many heat sources inside it such as engine and heat exchangers; therefore, managing the heat inside these compartments is vital and essential.	1-Analyzing the engine compartment and identify the heat sources 2-Identify the amount of heat released from each source and calculate the overall heat generated. 3-Analysis by CFD (3D) and thermal analysis (1D) software.
11		**Unmanned Ground Vehicle (UGV).**	Due to the need of special operations UGV's for rescue missions where human intervention is impossible this project arises. The project aims to develop an existing gasoline buggy car by selecting the optimum engine and other mechanical parts. also a development of simple control system with RC communication will be the base for more advanced control algorithms such as navigation and maneuvering. 	1-All related design documents. 2-All related codes and libraries built in KADDB's research section lab. Computer. 3-Selection of all needed mechanical parts such engine, gears etc.… 4-Design and implementation of all needed electrical systems. 5-Design and implementation of simple control system with RC communication. 6-A functional prototype.

KADDB Suggested Projects 2019

No.	Category	Topic	Description	Expected Deliverables
12	**Mechanical Systems**	**Rotary Actuator**	The Rear Doors For Some Military Vehicles Used As a Ramp For The Crew To Enter And Exit The Vehicle. To Open The Door On Certain Angle & Height From The Ground We Are currently Using Two Hydraulic Cylinders To Do The Job. The Task Is To Implement Other Principle To Open The Rear Door By Using Hydraulic Rotary Actuator. There Are Many Principles Used To Get Rotary Motion Like: 1-Convert the Linear Motion To Rotary Motion By Using Rack & Pinion. 2-Using Gears & Splines. 3-Vanes & Shaft. Using Hydraulic Rotary Actuator Will Add Many Advantages To Our Vehicle Design Like: 1-Wider & Flexible Opening Range. 2-Compact Design That Save Room. 3-Less Parts To Use & Less Hoses Connection. 4-Less Maintenance & Trouble Shooting. 5-Easy To Protect. 6-Easy To Calibrate & Synchronize. 7-Bigger Force & Pressure. 8-Less Oil Reservoir. 9-High Torque & Pressure. In this Project You Will Practice Torque & Moment Calculation In Addition To FEA	1-All related design documents. 2-All related codes and libraries built in KADDB's research section lab. Computer. 3-Selection of all needed mechanical parts such engine, gears etc.… 4-Design and implementation of all needed electrical systems. 5-A functional prototype
13		**Engine Air Circulation & Ventilation**	The Engine Air Ventilation System Currently Used In Our Vehicles is achieved By Using Engine Louvers. Therefore, The Air Is Circulated & vented Naturally Thru The Engine Louvers. The Task Is To Implement Another Method, Which is More Efficient To Circulate & Vent The Air By Force From The Engine Compartment Using Air Blowers Especially For Bigger Horse Power Engine. The Air Blower Will Suck The Gases (Hot Air & Other Gases) From The Engine Compartment & Exhausted Outside & Sucking Force Will Replace The Hot Air & Other Gases With Ambient Air. We will Achieve Many Advantages From This Implementation: 1- Cooling Down The Engine By Improve Air Circulation Process. 2- No More Louvers(Less Parts, Less Welding, Less Assembly & Less Design Hours). 3- Ballistic Protection Is Better.	1- All related design documents. 2-All related codes and libraries built in KADDB's research section lab. Computer. 3-Selection of all needed mechanical parts such engine, gears etc.… 4-Design and implementation of all needed electrical systems. 5-A functional prototype

KADDB Suggested Projects 2019

No.	Category	Topic	Description	Expected Deliverables
14	Computer Engineering, IT, and Software Engineering	**Drone controlled by VR HMD(VIVE) (phase 2)**	Virtual reality helmets, which allow drone pilots to fly and shoot targets from the comfort of a militarybase. The headset/helmet has high resolution of 5120x2180 pixels, and can control an unmanned aerial drone by simple head movements. The pilot only needs to move his head up or down to adjust the drone's altitude, while the turning of their head will steer the drone. As a Continuation on the phase one of drone VR controlled mentioned above, The second phase will focus more on the video transmission and control synchronization: - increase the video range - 100 sync with transmission of control commands and video transmission	1-All related design documents. 2-All related codes and libraries built in KADDB's research section lab. Computer. 3-A multi-rotor UAV prototype controlled by the VR headset
15		**FPGA based shredder**	The main purpose of this project is to develop a modular and extensible solution that is capable of securely sanitizing data in a way that is nondestructive to the storage media But ensures the irrecoverability of the stored information by any means. Sanitize a number of disks in parallel without interruption to the usability of the System using FPGA.	1-All related design documents. 2-All related codes and libraries built in KADDB's research section lab. Computer. 3-The implemented software.
16		**Forward error correction on (2, 3, and 4bit) data words (data words shall be called K), using Trellis code or if possible Turbo coding**	The function of a TCM consists of a Trellis code and a constellation mapper. TCM combines the functions of a convolutional coder of rate R = K/ (K+1) and an M-array signal mapper that maps 〖M=2〗^(K+1) constellation. The platform shall be arm microcontroller or FPGA and the interface shall be serial.	A hardware platform used in a software-defined radio in data level to be able to correct corrupted data at the receiver side.
17		**AES 256 encryption**	It's a 128 bits length block cypher, each block shall be encrypted, and then a frame shall be constructed, each frame contains the encrypted 128 block and, a start of frame, the start of frame shall be used to identify the start of encrypted 128 block at the receiver side. The AES code shall be provided to research team in C language. The platform shall be arm microcontroller or FPGA and the interface shall be serial.	A hardware platform used in a software-defined radio in data level before forward error correction.

KADDB Suggested Projects 2019

No.	Category	Topic	Description	Expected Deliverables
18	**Computer Engineering, IT, and Software Engineering**	**Fast Fourier Transform Demodulation FFT demodulation**	The input shall be 8-bit words at a maximum 300k samples per second depending on modulation scheme. Maximum 6K points shall be taken each time. If Fourier 3K points is used at 300k samples per second the basis, outputs will form 100Hz resolution. These basis outputs shall be used to determine the frequency spectrum with phase. According to modulation scheme frequency, phase, and amplitude shall be used to demodulate the incoming sampled points. Complex Fourier transform determines direction of shift of frequency and may not be needed if the input frequency bandwidth is much smaller than sampling frequency, modulated bandwidth is 3KHz in AM, 12.5 KHz in FM, data baud rate shall be maximum at 64 Kbps but bandwidth may be less depending on modulation. The platform shall be arm microcontroller or FPGA and the interface shall be serial	A hardware platform used in a software defined radio after down conversion and sampling (under sampling is suggested to be used).