



Jordan University of Science and Technology

Engineering Training Report

Student Name: **أحمد فايز عليان**

Student ID: **20070024171**

Department: **Electrical Engineering**

Training Institution:

King Abdulla II Design and Development Bureau (KADDB)

Training Duration: **From July 3, 2011 to August 29, 2011**

Date of report submission: **August 29, 2011**

Table of Contents:

Subject	Page
Table of contents	1
Table of Figures.....	2
Declaration.....	3
Training summary.....	4
Chapter 1: Institution profile and training outline.....	5
1.1 KADDB.....	5
1.2 Organization and Employees.....	5
1.3 Training Outline and Environment	6
Chapter 2: Practical Training.....	7
2.1 Identifying Current Projects and Following up the Work.....	7
2.2 Reading to Get Necessary Knowledge in Important Topics	9
2.3 Acquiring New Skills Such as Plotting and Soldering of PCBs	10
2.4 A Data Acquisition and Manipulation Task Using LabVIEW	12
2.5 Simple Circuit Design and Testing and Other Small Partial Tasks	16
Chapter 3: Impact of Engineering and learned skills in Training	19
Chapter 4: Conclusions	20
Chapter 5: Recommendations	21

Table of Figures:

Fig. No	Title	Page
1	KADDB logo	5
2	KADDB organizational structure	6
3	The general flow of the design process in KADDB	7
4	The Electric Drive Desert Ranger – project prototype	8
5	Remote Weapon Station II – project prototype	8
6	KADDB LTATV 3D model	9
7	Soldering equipment	11
8	A DAQ system as described by National Instruments	12
9	USB-6229 BNC top view	13
10	Single-axis ADXRS401 gyro sensor board by Spark Fun Electronics	13
11	Connection of the ADXRS401 chip and other components in the gyro board ...	14
12	Control panel of the final angle measuring VI, running with the sensor fixed ...	16
13	Schematic of the 555 timer based negative voltage generating circuit plotted in isis with simulation running	17
14	Designed PCB layout top and bottom views and component locations on the PCB top face for the 555 timer based negative voltage generating circuit	18

Declaration

This report was written by Ahmed Fayez Alyan, a student in the Electrical Engineering Department at Jordan University of Science and Technology (J.U.S.T.). It has not been altered or corrected as a result of assessment and it may contain errors and omissions. The views expressed in it together with any recommendations are those of the student.

Training Summary

- I have completed a two-month period of training at KADDB.
- KADDB is an independent government entity within the Jordan Armed Forces (JAF) that designs and develops defence products and security solutions.
- The work data of such a military institution is so sensitive that it must have strict security procedures to protect its products from theft especially by enemies who will find this info very useful. These strict procedures have large effect in limiting available information to include in this report. Only available information is included.
- Major projects that are taking concern in the Electrical and Electronic Design Department are: Target Auto-tracking, GPS Jammer and Distance Measurements.
- Meanwhile, they work on some somewhat small projects such as motor drive projects and simple meters (VM, LC meter).
- Academic material information is essential for the work of a design or development engineer more than any else job of an engineer. He/she should remember much of what he/she studied at university and at the same time learn more and more to keep in track with new technologies and researches.
- In the laboratory I stepped large steps in improving my skill and understanding in soldering and desoldering electronic boards and components.
- I learned typical steps for deigning electronic devices: design circuit schematic, simulate it, breadboard test, design PCB layout, print PCB using PCB printing machine, solder discrete components, test the complete PCB then connect it to the integrated system with proper packaging.
- The main, longest-term and most useful part of my training was working on LabVIEW, data acquisition (DAQ) hardware and software and a gyro sensor to integrate a successful instrument that reads the angle by which the gyro is directed with good precision.
- This work attracted concern and admiration of my fellows and managers.
- This success has been achieved by following a patient step-by-step procedure and reading necessary information in each step. Once I read about DAQ in LabVIEW manual and in another step I read the datasheet of the gyro sensor.
- During the training period, I was submitted small tasks for helping in projects or self-learning such as making AutoCAD plots, programming PICs and designing or searching for simple circuits.
- I think that my most important outcome from training in KADDB is acquiring many new useful skills of various types and developing some of my existing skills. I think these skills are very valuable since they can signify an impact in solving problems.
- However, the main disadvantages of training at KADDB, as I think are the innovation limiting strict security procedures and the lack of a precise training plan.

Chapter 1: Institution Profile and Training Outline

1.1 KADDB

Established in 1999, The King Abdullah II Design and Development Bureau (KADDB) (See Figure 1) is an independent government entity within the Jordan Armed Forces (JAF) that aims to be the globally preferred partner in designing and developing defence products and security solutions in the region. The presidency building of KADDB is located in Amman / Jordan just close to the third circle in Jabal Amman. On the other hand, the wide production area of KADDB, where I have trained, is located between Ad-Dulail in the Zarqa Governorate and Al- Khalidiyah in the Mafraq Governorate, next to the KADDB industrial Park.



Figure 1: KADDB logo

The scope of work conducted by the Bureau covers the full spectrum of Defence Design and Development, Test and Evaluation, Technology Incubation in the Kingdom, as well as Defence Technology Training. The Design and Development tasks are initiated with the user requirement based on the nature of the threat and threat analysis through concept design and development, to the identification and acquisition of enabling technologies, which is followed by prototyping. The Test and Evaluation is then done at the Test and Evaluation Centre which conducts independent evaluations and experiments in the field of land vehicles, weapons, ammunition, military equipment and armour material testing. This centre serves the different entities of JAF, Law Enforcement Agencies and external customers. For commercial production and investment, successful designs fulfilled by KADDB are presented to associated companies known as KADDB Investment Group (KIG), which is the commercial arm for KADDB.

By applying its strategy, the Bureau aspires to build up the efficiency of the human element and the qualifications of the engineers, enrich their knowledge in scientific research and design and development, as well as find applicable solutions that would fulfill the defence needs. In addition to the above, KADDB's relationship with Jordanian Universities is represented by creating the right environment for students to apply their research and scientific projects, and adopt the applicable projects to serve the objectives of the Bureau.

1.2 Organization and Employees

The simplified organizational structure of KADDB is shown in Figure 2. Exact information about the number and job descriptions of the company employees cannot be provided because of the confidentiality policy of such a sensitive institution and because of the very large number of employees but we can say that there are many technicians and engineers with variant degrees and these form the majority of employees.

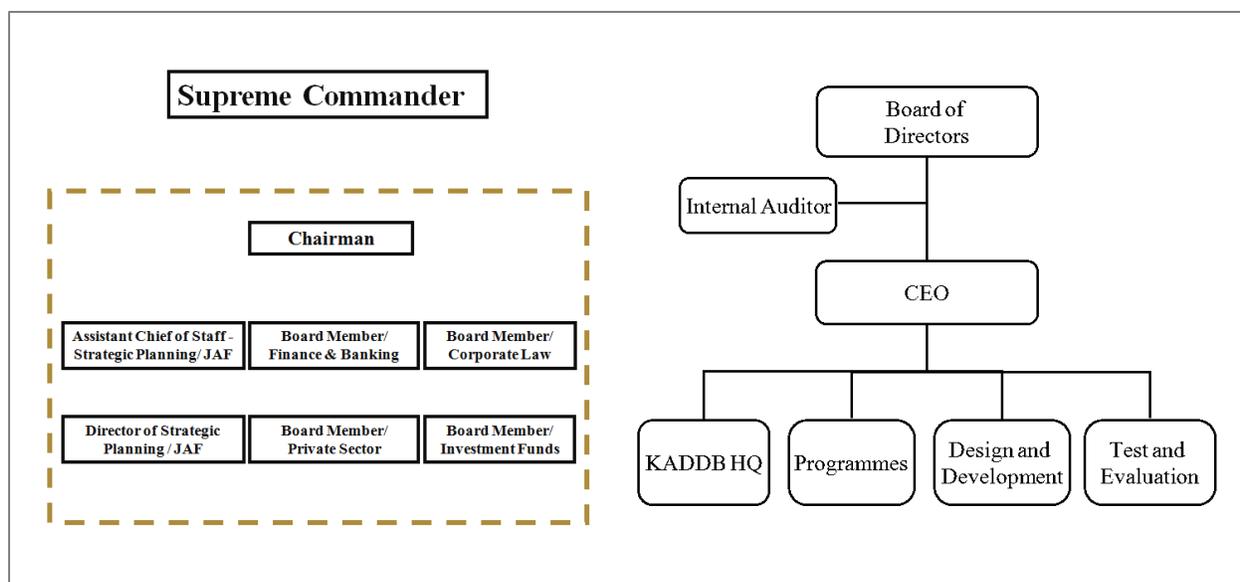


Figure 2: KADDB organizational structure
(CEO = Chief Executive Officer, HQ = Headquarters)

1.3 Training Outline and Environment

I have spent the major part of the period of training in the Electrical and Electronic Design Department included in the Design and Development Unit. More specifically, most of my training was at the Electronic Design Section, the supervisor of which is Eng. Adnan Ishtay, my direct manager, and in the Research Section (the laboratory). However, my training supervisor in the section was Eng. Ahmed Abu Al-Haija (mobile no.: 0788217489, e-mail: aabuhaija@kaddb.mil.jo), a design engineer. I also worked with Eng. Yazeed Khattabi and Technician Asaad Al-Masharfah who also work in the section.

One main disadvantage of my training was the lack of a precise training program as a result of the nature of work in design sections. The nature of work implies that my plan cannot be independent from what is being worked on in the section, so the plan is dependent on the department work in the two months, which is not precisely planned. However, I was given a printed training schedule within the first week of training and it listed major topics of special concern and importance in the department to learn and time given to each. I have learned many of these topics but not as listed in the plan (from time aspect). The plan topics which I learned are mainly the following.

- Learning different programs such as DIP Trace (for Printed Circuit Board; PCB, design), C language for PIC programming and Proteus Simulator.
- Studying the common types of serial interfaces: RS232, RS422 and RS485, and how to communicate with a computer using them.
- Designing Pulse Width Modulation (PWM) circuits.

In fact, the time I spent with these topics is small compared to topics that came during training, mainly the following.

- Learning and working on data acquisition (DAQ) and LabVIEW.

- Studying the characteristics of a gyro sensor and working on it.
- Acquiring skills of electronic board soldering and applying them.
- Designing or searching for simple circuits.

Chapter 2: Practical Training

2.1 Identifying Current Projects and Following up the Work

A first step in any training program is to become familiar with the work environment and how it flows. About eight days at the beginning of the training period were spent on only monitoring how the staff around me works and what they work on. In this stage, I could understand the general sequence (flow) of the design process and the role of the design and development unit within it, which I depict in Figure 3.

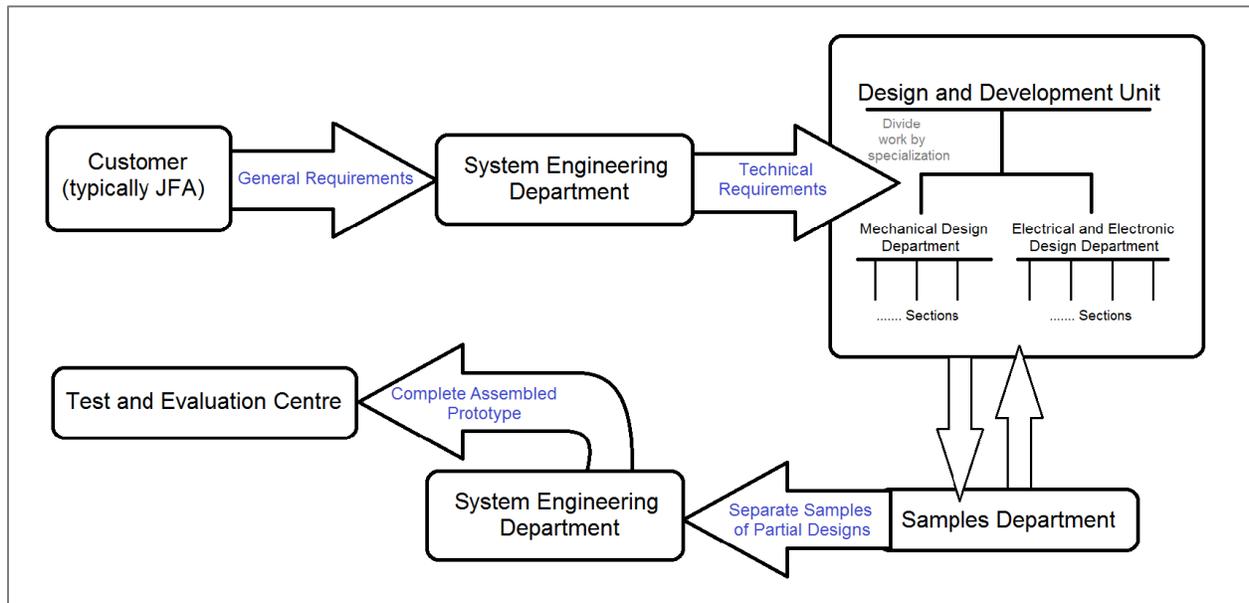


Figure 3: The general flow of the design process in KADDB

Some complete project prototypes that I saw in the Samples Department are the Electric Drive Desert Ranger (See Figure 4) and the Remote Weapon Station II (See Figure 5). A detailed description of these two projects can be found on the KADDB official website: http://kaddb.mil.jo/Public_projects/ListProjects.aspx?cat_id=1&lang=2



Figure 4:
The Electric Drive Desert Ranger – project prototype



Figure 5:
Remote Weapon Station II – project prototype

On the other hand, some projects in the section were incomplete despite being in the hardware stage because of having many troubles in their operation. These projects occupy the major concern of the Electronic Design Section at this time. These projects are the following.

- Target Auto-tracking: It uses image processing in MATLAB to pick a target appearing on the camera image and keep following (directing the camera toward) it using a feedback system and a stepper motor as an actuator. This way, a weapon carried on this system is automatically directed into its target.
- Distance Measurement: It uses two cameras directed parallelly and separated by a fixed reference distance. The two images are processed in MATLAB to determine the shift of the object of concern between the two images and then using this value to determine how far it is using geometric relationships. This project is complete except that it has a large error in measurement and needs corrections.
- GPS Jammer: Aimed at preventing the enemy from recognizing his location, this project is intended to block the Global Positioning System (GPS) signal in a region. The global GPS signal is at frequency 1.57542 GHz which is somewhat high; it is a Radio Frequency (RF) signal. This project is divided into an Intermediate Frequency (IF) part for power and control and an RF part. The awkwardness of RF circuit analysis and design and the little expertise in this domain made this project difficult that it failed many times.

One further large project that is currently attracting a major concern of KADDB as a whole at this time is the Light Tactical All-Terrain Vehicle; LTATV, which can be said to be fully design by KADDB not only developed. A 3D plot of this vehicle is shown in Figure 6. This

Vehicle (KADDB LTATV) is exclusively designed to meet the defence capabilities of the Jordan Armed Forces. The Light Tactical 4x4 ATV can be easily deployed by land, sea, and air (C130 or Helicopter). Being currently assembled in the System Engineering Department, this project is in its final steps now but not completed yet. When I visited the System Engineering Department electrical technicians were connecting electrical components of the vehicle such as connecting the dynamo to the battery and connecting sensors to a panel when it was still a structure.



Figure 6:
KADDB LTATV 3D model

2.2 Reading to Get Necessary Knowledge in Important Topics

The nature of work in KADDB, especially in the Design and Development Unit is very special and distinguished that it is actually rare in a country like Jordan. Design and development institutions especially in electrical and mechanical domains are generally rare in such a country. The reason of this is that this atypical domain demands high financing, advanced technologies and advanced scientific research. Further, design and development engineers should be smart and academically distinguished. A design engineer should be remembering many of his academic courses and should also keep acquiring new necessary information. This explains why most engineers I saw in KADDB are chosen young. From this aspect, my training in KADDB cannot be started before I get some new technical information that has importance in the section where I train. This is why I was told to read some of these topics in the library before I can start. This took about three days of training.

My reading in the library was about two main subjects:

- LabVIEW and Data Acquisition: Described in detail in section 2.4.
- Different Types of Serial Interfaces for Digital Data Transfer: I read about the most common three types: RS232, RS485 and RS422. This was useful to know although I did not use it in my training. These interfaces are used typically to communicate digital data with computers. The following table summarizes features of these interfaces.

<u>Characteristics of RS232, RS422, RS423 and RS485</u>			
	RS232	RS422	RS485
Differential	no	Yes	yes
Max number of drivers	1	1	32
Max number of receivers	1	10	32
Modes of operation	half duplex full duplex	half duplex	half duplex
Network topology	point-to-point	Multidrop	multipoint
Max distance (acc. standard)	15 m	1200 m	1200 m

	RS232	RS422	RS485
Max speed at 12 m	20 kbs	10 Mbs	35 Mbs
Max speed at 1200 m	(1 kbs)	100 kbs	100 kbs
Max slew rate	30 V/ μ s	n/a	n/a
Receiver input resistance	3..7 k Ω	\geq 4 k Ω	\geq 12 k Ω
Driver load impedance	3..7 k Ω	100 Ω	54 Ω
Receiver input sensitivity	\pm 3 V	\pm 200 mV	\pm 200 mV
Receiver input range	\pm 15 V	\pm 10 V	-7..12 V
Max driver output voltage	\pm 25 V	\pm 6 V	-7..12 V
Min driver output voltage (with load)	\pm 5 V	\pm 2.0 V	\pm 1.5 V

2.3 Acquiring New Skills Such as Plotting and Soldering of PCBs

During the training period I spent in the Electronic Design Section, I could recognize a typical sequence followed in the process of designing a small electronic device in specific. I explain this in the following points.

- First they design the circuit or search for it on the internet and draw its schematic.
- Then they make software simulation to ensure that it operates right as desired. Typically, Proteus isis is used.
- When simulation succeeds, sometimes, they configure the circuit using DIP components on a breadboard to test it in hardware.
- When the breadboard circuit operates as desired, they move to designing the layout a suitable printed circuit board (PCB) layout, which is the usable form of an electronic circuit. This is typically done using DIP Trace by first plotting the schematic and then converting it to a PCB layout but is also sometimes done using Proteus ARES after plotting the schematic in Proteus isis. A smaller PCB is always preferred and a single-sided PCB is preferred on a double-sided PCB.
- Then the PCB is printed on a butter paper for the PCB machine. Until this point, work is all done in the Design Department.
- The next step is to insert the butter paper in the PCB printing machine, which is in the Samples Department, to print the PCB itself on a plastic board. The raw plastic board is a piece of plastic totally covered from both sides by a layer of copper. Ultraviolet (UV) rays inside the PCB machine strike the raw board through the butter paper, penetrating the blank areas and stopped by the black areas. Copper that is stroke by UV rays changes chemically to a material that is dissolvable in the machine acid. Thus, when the board is then immersed in the acid copper on the surfaces takes the shape of the designed layout.
- The ready PCB is then taken back to the Design Department, where discrete components are soldered to their places and the PCB as a whole is connected to other components, possibly PCBs and so on. The system is tested again at this stage against mistakes of soldering or PCB printing.

- When the device is complete, it is packaged with a suitable designed package in the Samples Department along with control panels, etc.

Soldering and desoldering is thus a skill worth learning. So, I practiced and learned much of it in the laboratory. Next I explain the role of some equipment and material used in soldering and desoldering.

- Solder (1): A deformable metal-alloy electrically-conductive wire which is the material by which electronic components are fixed. Before applying or removing solder it should be melted by heated soldering iron or something else (typically at 400°C).
- Soldering iron (2): An iron pin with thermally isolated handle, heated to the required temperature to melt solder when applying or removing it.
- Soldering iron stand (3): Necessary to carry the soldering iron when it is left hot to prevent any damage or harm.
- Solder sponge (2): A metallic sponge used to clean the soldering iron from suspended solder.
- Heat gun (4): An alternative of the soldering iron for special cases. It blows hot air at the necessary temperature to melt solder for fixing or removal. It is used for tiny objects such as chips in a ball grid array (BGA) surface-mount package (We used it for the gyroscope chip ADXRS401 explained in section 1.4).
- Desoldering pump (5): A very important tool that uses air pressure to suck melted solder from the board.
- Solder wick (6): For tiny objects, solder wick is used for desoldering. This is a copper strip that sucks melted solder by capillary action.

Figure 7 shows these soldering equipments numbered 1-6, corresponding to the same number in the braces next to each above.

Also, I could learn the basics of plotting PCB layouts using Dip Trace by watching how engineers work on it and by taking a practical lesson.

Some useful concepts related to soldering and PCBs are the following.

- ❖ Via: Solder inserted into a through-hole in the PCB to electrically connect between pads on both faces of the PCB.
- ❖ Jumper: An ordinary isolated wire soldered as necessary between any two points on the PCB. This is used as a last solution when this connection is hopeless to be done in the PCB layout itself.
- ❖ Pouring: The widest area of copper on the surface of the PCB usually chosen to be ground. This area is included when the PCB layout is drawn in order to save acid in the PCB printing machine.



Figure 7:
Soldering equipment,
numbered 1-6

2.4 A Data Acquisition and Manipulation Task Using LabVIEW

This was the main and the most useful part of my training. When I made the interview with Eng. Adnan Ishtay, my direct manager, for acceptance as a trainee, he became so impressed when I told him that I have good ability and expertise to deal with LabVIEW since I use it as the main tool in my graduation project. He said that this ability should be invested since no one in the section had it except himself, slightly. So, in an early time, he gave me a complete tutorial of LabVIEW and its subsequent topics from the mother company, National Instruments (NI), in order to increase my knowledge in some important topics in which I have little knowledge. This was very useful even in achieving progress in my graduation project.

LabVIEW and Data Acquisition

LabVIEW can be said to be simply a graphical programming language with extended abilities. Rather than using line codes for programming, in LabVIEW, you create a block diagram and a control panel. The block diagram is a graphical and friendly way to tell LabVIEW what to do and it controls the control panel, which contains controls (inputs) and indicators (outputs) for the user, representing the goal of a LabVIEW design. LabVIEW programs (a block diagram + a control panel) are called virtual instruments, or VIs, because their appearance and operation imitate physical instruments, such as oscilloscopes and multimeters. LabVIEW contains a comprehensive set of tools for acquiring, analyzing, displaying, and storing data, as well as tools to help you troubleshoot code you write. It is also well known as a good tool for signal processing abilities and automation through computers.

One of the biggest advantages of LabVIEW is its ability to create real-time applications easily by communicating with hardware, one type of which is data acquisition hardware, known shortly as DAQ. Data acquisition (data collection) is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. The components of data acquisition systems include:

- Sensors that convert physical parameters to electrical signals.
- Signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values.
- Analog-to-digital converters, which convert conditioned sensor signals to digital values.

A DAQ system as described by National Instruments is shown in Figure 8. A terminal block consists of screw or spring terminals for connecting signals and a connector for attaching a cable to connect the terminal block to a DAQ device, which in turn is responsible for processing signals before conversion, sampling them and analog-to-digital conversion.

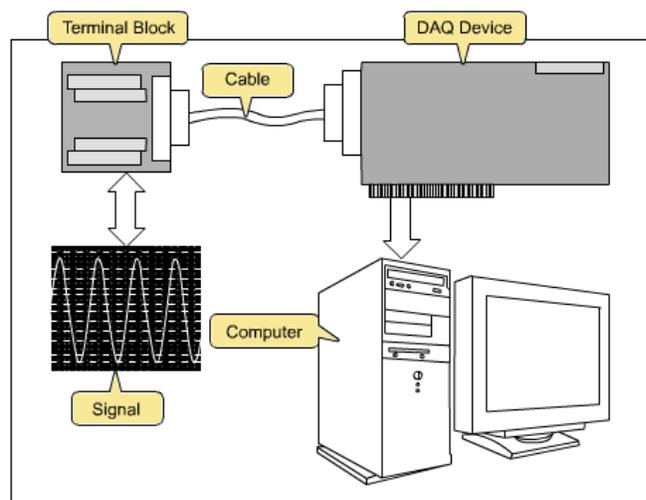


Figure 8:
A DAQ system as described by National Instruments

Getting Started

In the laboratory, I saw some valuable NI products which are: NI ELVIS (The National Instruments Educational Laboratory Virtual Instrumentation Suite), a small PCI terminal block, a DAQ board to be connected inside a PC and USB-6229 BNC, the hardware device which I worked with all over the time. USB-6229 BNC comprises both a terminal block and a built in DAQ device and communicates with a computer using a USB interface and has too many channels for input and output, which make it very valuable. Figure 9 shows how USB-6229 BNC looks from top view.



Figure 9:
NI USB-6229 BNC top view

One problem I had with LabVIEW at the beginning was that my knowledge was limited only to pure software applications and I knew nothing about how to communicate with hardware and how to create a real-time application, so, I was unable to use DAQs in the laboratory. This motivated me to read much about data acquisition in the LabVIEW manual until I got good knowledge about the subject. However, I could not connect the hardware to PC till Eng. Ishtay connected USB-6229 BNC to a PC and taught me how it can be tested and used as a simple oscilloscope or function generator using the NI Measurement and Automation software (NI MAX). Then I could individually deal with the hardware using NI MAX.

At this time Eng. Ishtay submitted me a data acquisition task that is not easy: to use the signal of a single-axis gyro sensor (gyroscope) and use data acquisition and processing in LabVIEW to read the angle by which the sensor is directed. An initial point to say is that the gyro signal is proportional to the angular speed by which it is rotated, and thus, integration is required to read the angle, an operation known to have the problem of accumulating error. To get started with the task I had to read the datasheet of the gyro and read about how to take data acquisition data to LabVIEW for processing.

Gyro Sensor

The single-axis gyro sensor in the laboratory was a tiny board assembled by Spark Fun Electronics, as the one shown in Figure 10. The essential component in the board, which is responsible for sensing, is ADXRS401, a chip in a ball grid array (BGA) surface-mount package from the Analog Devices company.

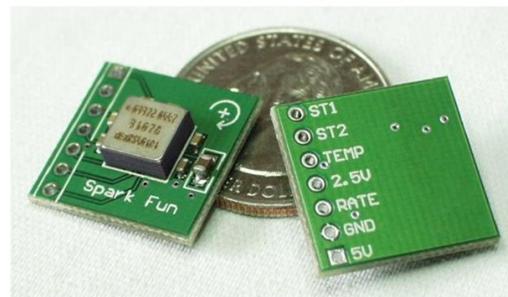


Figure 10:
Single-axis ADXRS401 gyro sensor board by Spark Fun Electronics

We can summarize the points of concern about this gyro sensor as read from the datasheet and by testing it using an oscilloscope in the following points.

- The connection of the ADXRS401 chip and other components in the board is as shown in Figure 11.

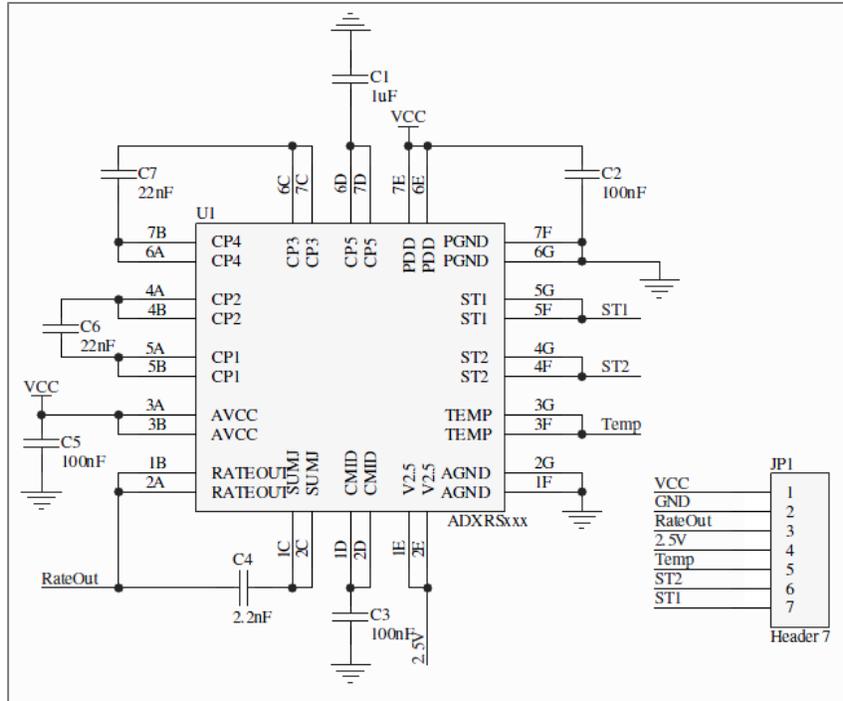


Figure 11:
Connection of the ADXR401 chip and other components in the gyro board

- The output signal is at the RATE or RATEOUT pin and VCC should be at 5 V, where the reference is GND.
- When the sensor is stationary, the output signal at RATE should be constant at 2.5 V nominally. This is the measurement null or reference. The 2.5 V pin is supposed to be the exact reference, but testing showed that this is not accurate, at least for the sensor tested.
- The voltage value by which the RATE output is shifted from the measurement null is proportional to the angular speed by which the gyro is rotated around the axis perpendicular to its plane and the arrow indicates the positive-shift direction.
- Sensitivity of this shift is nominally 15 mV/(°/s).
- The dynamic range for measurement is ± 75 °/s.

Design

Reaching the summit represented by achieving a VI in LabVIEW that reads the angle by which the gyro is directed was done by a step-by-step procedure where in each step I had to read more before I try. These steps are mentioned in the daily logbook and are explained in the following points.

- I read in the LabVIEW manual about data acquisition virtual instruments (DAQmx VIs) and how to use them to input an external signal acquired by a DAQ hardware into LabVIEW continuously in two ways: sample-by-sample or block-by-block, using a buffer to store a specified number of samples each time. Then I applied both methods practically using a function generator for test input signals and succeeded. The second method is called continuous buffered acquisition.

- I searched LabVIEW for a suitable VI that integrates a signal and chose the Time Domain Math Express VI and tested it successfully. Since signal input to this VI should be in blocks of samples I chose continuous buffered acquisition as my data acquisition technique.
- Then I combined continuous buffered acquisition with the integration VI to make a VI that acquires an external signal as successive blocks of samples and integrates it periodically. Testing this using the function generator showed success.
- I made a scale in NIMax to convert the signal of the gyro from units of volts to degrees per second ($V \rightarrow ^\circ/s$) by removing the about 2.5 V null voltage then dividing by the nominal sensitivity of 15 mV/($^\circ/s$).
- Then the scaled gyro signal was input to the acquire-and-integrate VI to read the angle and the result was successful in principle. However, the effect of noise and error in null determination lead to unacceptable accumulation of error in the integration process.
- To remove this effect many I attempted many techniques such as filtering and reading null dynamically but they failed.
- Finally, after many attempts, I found a good way to solve the problem: input gyro direct signal into a moving average filter, then remove null and then quantize it to prevent noise from affecting (scarifies some accuracy) before integration. The result was much better than before and angle could be read with little error, where the reference (zero angle) corresponds to the direction of the gyro at the instant of starting running the VI. A lasting problem was the inaccuracy in determining the sensitivity which caused angle reading to be inaccurate. This problem requires measuring the sensitivity accurately or using this VI itself by fixing the sensor properly and moving it in precise angles for calibration (I left sensitivity controllable). This is all what I did.

The control panel of my final VI, called Gyro read angle.vi, while it is running with the sensor fixed is shown in Figure 12.

Note: Due to strict security procedures in KADDB, I could not get the final block diagram out to include in this report.

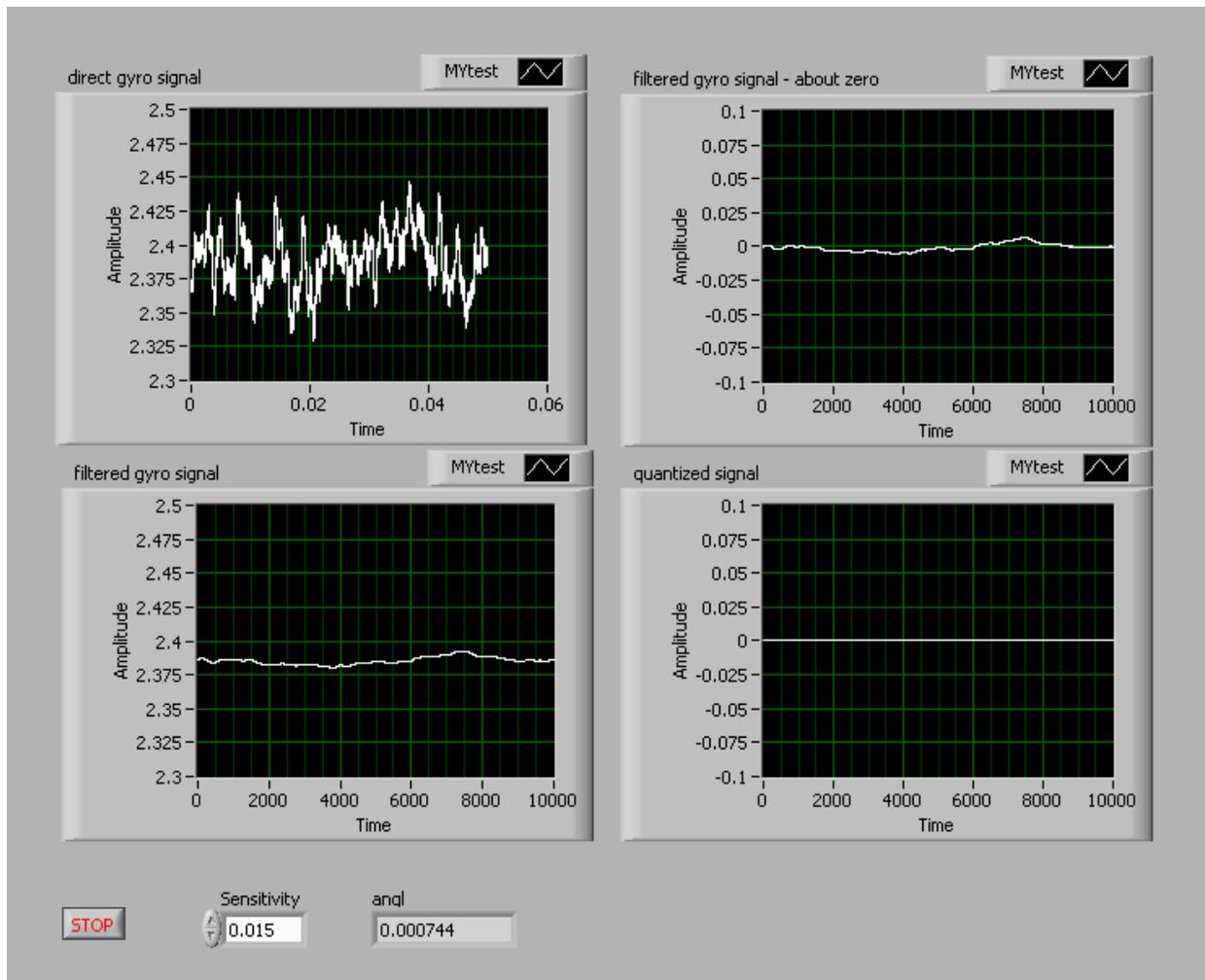


Figure 12:
The control panel of the final VI, while it is running with the sensor fixed

2.5 Simple Circuit Design and Testing and Other Small Partial Tasks

During the training period, I was given some small partial tasks to learn from and to help in projects. One task from Eng. Yazeed Khattabi was programming PIC 16F887A to generate pulse width modulated (PWM) signals, which are digital signals with a constant frequency and variable duty cycle. PIC 16F877A has a specialized PWM hardware module with dedicated registers. I could generate real PWM signals with constant and time-variant duty cycles using a ready 40-pin PIC board. This was very useful. Another task with Eng. Abu Al-Haija was making some 3D plots in AutoCAD 2010 for the purpose of documenting the Distance Measurement project. This helped me to refresh my AutoCAD drawing skills.

Further, in the last days of training, When I stopped working on the task of reading angle using a gyro and LabVIEW, I started helping my supervisor, Eng. Abu Al-Haija in making some simple circuits for the IF part of the GPS jammer project. Mainly, I worked on two circuits.

- DC Supply Voltage Inverter; 12 V to -12V.
- Sawtooth signal generator: I simulated a proposed circuit using Proteus isis and tried to get the desired sawtooth signal output by tuning component values.

Indeed, I worked more on the first circuit. This circuit generates a negative-voltage supply from a positive supply without any negative input. Searching for a circuit on the internet with a fellow trainee, we found a 555 timer based circuit which is simple and cheap. We first simulated the circuit with Proteus isis and the result was not as exactly desired; with +12 V input, the output did not reach -11 V. The schematic of the circuit plotted in isis with simulation running is shown in Figure 13. Nevertheless, we accepted this result and continued with this circuit and designed a very small, double-sided PCB layout for it using Proteus ARES. Figure 14 shows the designed PCB layout top and bottom views in real (1:1) scale and the component locations over the PCB top face in a zoomed-in scale. In another day, I brought components of this circuit from the Samples Department for testing on a breadboard. After connecting on the breadboard the result was just similar to the simulation result; output voltage was about -10.5 V.

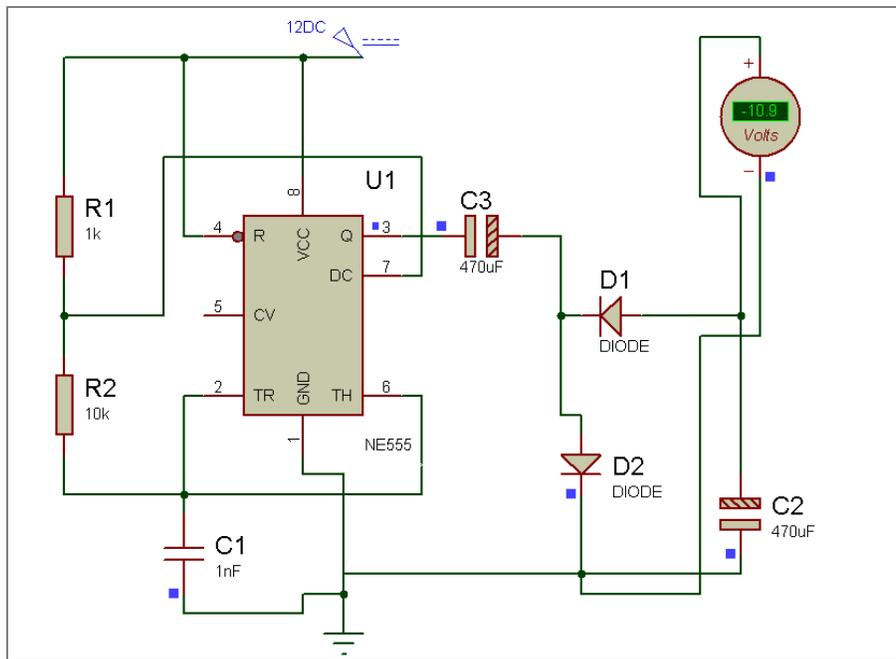


Figure 13:
The schematic of the 555 timer based negative voltage generating circuit plotted in isis with simulation running

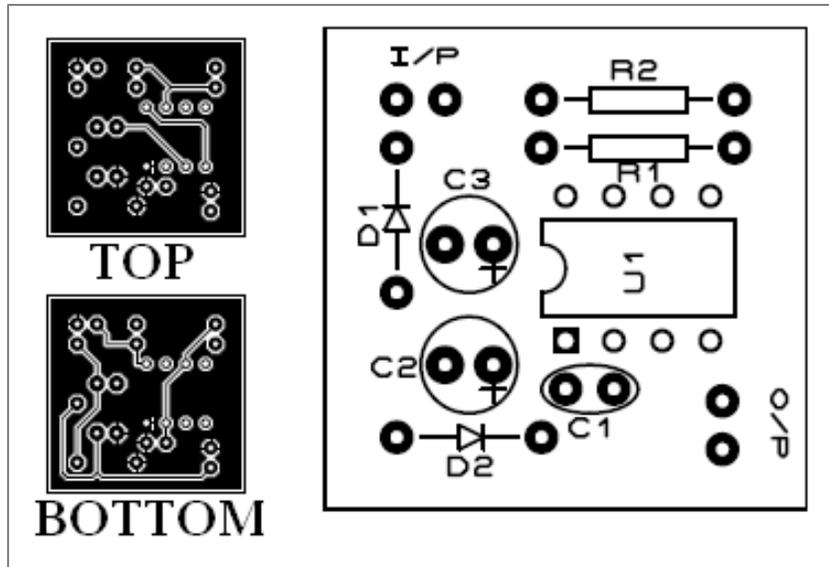


Figure 14:
the designed PCB layout top and bottom views in real scale
and the component locations over the PCB top face in a
zoomed-in scale.

This somewhat unsatisfactory performance motivated me to look for another circuit with better performance and less components. Many available chips found on the internet act as charge pumps that can supply negative voltage from only positive inputs, but the difficulty was to find a chip that inverts voltage as high as +12 V. Finally, after a long search, I found a Microchip chip TC1044S that inverts up to +12 V to up to -12 V and requires little and simple components. So, we demanded this chip as an alternative to the 555 timer circuit. Unfortunately, we could not simulate this new circuit because the chip is unavailable on Proteus isis.

Chapter 3: Impact of Engineering and Learned Skills in Training

In fact, my training in KADDB was very useful to me in acquiring new engineering skills that I had not had before. These learned skills prove being very valuable by signifying an impact in solving problems. It is well known that engineering skills have vital importance in design problems specifically. Some of the areas, problems and difficulties in which the engineering skills I learned signified an impact in solving problems are the following.

- Damage in an electrical device, which may be very necessary, is a common problem that occurs repeatedly and everywhere. An engineer having skills of troubleshooting the device using simple equipment can solve such a problem. I feel that I have improved this skill during the training period. The work of technicians in engineers in KADDB is not limited to designing and prototyping military-related devices. They also repair any device in the laboratory or elsewhere that goes faulty, if they can. E.g. I have participated in repairing the timer in a paper cutting machine by troubleshooting. This motivated me to try to repair any damaged electrical device in my home.
- When a problem arises where designing a technical project is required, the improved technical skills in using specialized software for simulation, programming, plotting, instrumentation, etc, and in dealing with hardware become very useful and helpful in increasing design efficiency. Such a project could be an academic project or an industrial project, such as KADDB projects. Design engineers in KADDB use these skills extensively when working on any project.
- Skills of teamwork and planning are universally desired since they increase the efficiency of any project in terms of time and money.

The next chapter lists skills that I have acquired or improved during my training. With no doubt, each of these skills has its usefulness that using it can help in solving of an arising problem.

Chapter 4: Conclusions

In conclusion, I am well satisfied with my training. I have learned many new technical subjects, acquired a number of new technical skills and improved another group of existing skills, other than those gained at university laboratories. What I liked most about my training is that it is very strongly related to academic materials and laboratories we studied in the university. This refutes the common saying that very little of the materials taught in university engineering courses is used by engineers working in the labor market. This dependency (relationship) is clearest in engineering design and development, which is the nature of work in KADDB. However, this does not mean that I have learned little new things in my training. I may count the technical skills that I learned or improved at the training site, other than those gained at university laboratories, in the following points.

1. Recognizing new types of serial interfaces and learning about them.
2. Large improvement in my ability to use Proteus isis software to simulate any circuit.
3. Getting the ability to design PCB layouts using DIP Trace or Proteus ARES; this is a totally new skill to me.
4. Large steps in improving my abilities in soldering and desoldering of electronic boards and learning more about the related concepts.
5. Increased skills in repairing faulty electrical devices by trial and error techniques, known as troubleshooting.
6. Improving my skills in building LabVIEW VIs. This helped me much in my graduation project.
7. Applying different types of data acquisition with DAQ hardware and LabVIEW software successfully for the first time.
8. Learning how to deal with any new sensor, chip or any electronic component by referring to its datasheets.
9. Increasing my understanding of how a successful design process should flow in a step-by-step sequence with troubleshooting arising problems and reading more at each step. This was gained by both practicing and monitoring work.
10. Increasing my ability to work as a member in a team. Actually this had been a problem of mine; I did not believe much in teamwork. Now, after the training, I can say that my belief in the benefits of teamwork, when the team is concerted, has increased a lot.
11. Acquiring increased ability in dealing with PIC microcontrollers and programming them. One new thing I learned is how to use the PWM module, or even any module by referring to the datasheet of the PIC.
12. Refreshing my skills in AutoCAD drawing.

It is very good to acquire such a large number of skills in a two-month training period. So, training at KADDB can be said to be very valuable.

Chapter 5: Recommendations

In this chapter, I give my opinion about training in KADDB and in general. Since previous speech focused on advantages of training at KADDB, I will focus here on the disadvantages and provide recommendations concerning them.

As stated before, one main disadvantage of the training was the lack of a precise training program as a result of the nature of work in design sections. The nature of work implies that the training plan cannot be independent from what is being worked on in the section, so the plan is dependent on the department work in the two months, which is not precisely planned. To resolve this problem I recommend that at the beginning of the training period the training supervisor determines with the trainee which of the current main projects in the section, or department, to involve him / her in according to his / her tendencies. This should not be a time-distributed schedule but only a listing of projects in which he/she will be submitted partial tasks. Otherwise, the trainee would find himself disorganized or having nothing to do for a long time. I think that partial tasks that are achievable the short period of training are best fit to trainees. A trainee should not be submitted a complete project or asked to start a new project. This is useless.

Another problem was the negative effect of the large load of work on the design engineers which caused them to ignore trainees totally for many days. I think if they involve trainees well from the beginning to carry a partial loads of the projects, this would be helpful.

Furthermore, I see that some security procedures in KADDB are too strict and exaggerated that they effectively limit innovation by engineers and trainees. For example, USB memories are blocked by computers, mobiles are prevented, internet service is limited and even a necessary simple operation like transferring data between two computers involves complications. I recommend that such strict procedures be mitigated to facilitate innovation in an innovation based institution like KADDB. The action and work of trainees is also limited by the slowness of procedures of assigning personal computers to them, creating their own user accounts and installing technical programs they want to work with.

Here is another point to say. Admitting the necessity of reading and acquiring new knowledge in engineering design, a trainee should not spend much time in this. At the end, training aims at acquiring practical skills and so, the trainee should be early involved in work, even if he/she will make mistakes. Sometimes, asking the trainee to keep reading in the library is intended to escape him!

However, the valuable benefits I gained from training at KADDB lets my overall evaluation of training there be: very good. Finally, regarding the training program at university in general, I think there should be more equity between students. The net training periods should be equal or close. I think that if training days are three or two a week, training will not achieve its goals. However, a general recommendation to training institutions is to try to get maximum benefit from trainees instead of ignoring them. Energy of the employees should be best invested since this will achieve common interests of the trainee (practical expertise) and the company (additional human resources).