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WindTel: An Automated Wind Tunnel Redesign Report #2

by

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Course: ICOM-4217, Section 080
Date: September 12, 2018

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Fig. 1: System Architecture

II. Expected System Lifecycle

1. Block

Needs & Opportunity

The present assignment of the needs of the Department of Civil Engineering's wind tunnel. In particular, Prof. Kart Zandbergen has a system that will simulate the measuring of several static parameters from a wind tunnel. A past attempt at a solution to this need was a project known as Aerobase, done by students of this same course in 2013. This present project represents the refinement and replacement of the past system.

2. Design

Functional Coverage

I. Block Diagram

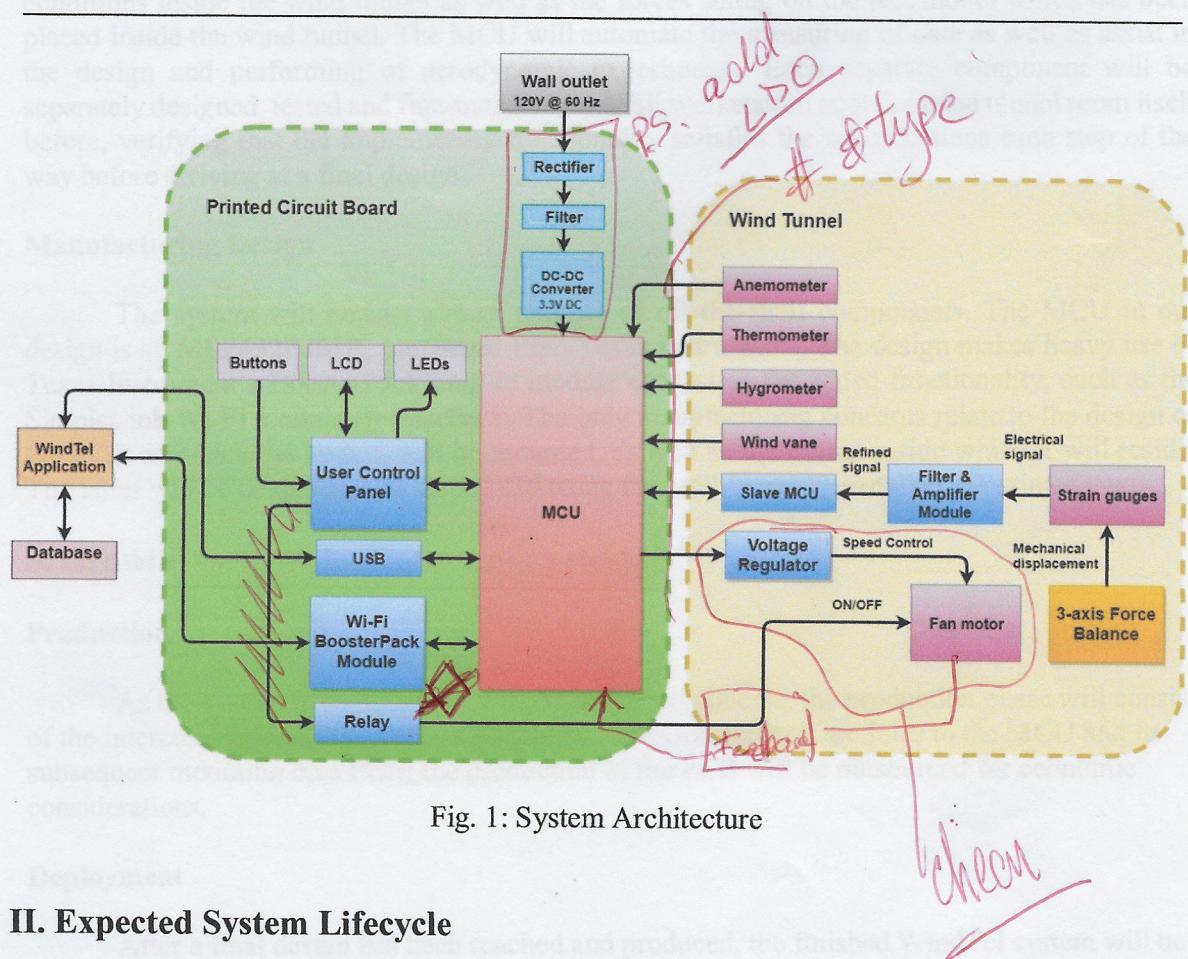


Fig. 1: System Architecture

II. Expected System Lifecycle

1. Birth

Need & Opportunity

This project arose out of the needs of the Department of Civil Engineering's wind tunnel. Its administrator, Dr. Raúl Zapata, requires a system that will automate the measuring of aerodynamic parameters inside the wind tunnel. A past attempt at a solution to this need was a project known as *Aerobal*, headed by students of this same course in 2013. This present project represents the retirement and replacement of that past system.

2. Design

Functional Concept

Our system consists of a microcontroller and various peripherals which will measure the conditions inside the wind tunnel as well as the forces acting on the test model which has been placed inside the wind tunnel. The MCU will automate the measuring of data as well as assist in the design and performing of aerodynamic experiments. Each separate component will be separately designed, tested and fine-tuned at our MSL workstation or at the wind tunnel room itself before, verifying that the implemented functionality satisfies the specifications each step of the way before arriving at a final design.

Manufacturing Design

The system will consist almost entirely of off-the-shelf components. The MCU in our design is an MSP432P401R, purchased from Texas Instruments. The design makes heavy use of Texas Instrument's BoosterPack plug-in module ecosystem for added functionality, such as the SimpleLink Wi-Fi module BoosterPack. The only manufacturing concerns relate to the design of the PCB on which the system will be mounted, as well as the casing inside which it will reside. The latter will be designed, and 3D printed using the MSL's newly-installed 3D printer.

3. Growth

Production

As the system is composed of off-the-shelf components, the production phase will consist of the interconnection of the various peripherals and BoosterPack modules to the MCU and its subsequent mounting on a PCB; the production of the PCB will be outsourced for economic considerations.

Deployment

After a final design has been reached and produced, the finished WindTel system will be installed at Dr. Zapata's wind tunnel in the Department of Civil Engineering.

4. Maturity

Maintenance

WindTel has been designed in such a way that it will be easy to detect the faults it may have in the future. In the case of hardware, the cables will be labeled and distinguishable in such a way that it will be easy to fix or replace if necessary. In the case of software, it will be easy to maintain through the internet by fixing, improving, adding and/or removing features as necessary.

*SW and HW Maintenance
How?*

Upgrades

It is possible to add more features either hardware or software, by adding booster packs to our MCU and implementing new features on the source code. There are a vast variety of booster packs for different purposes such as for displaying of graphs, tables, among others, as well as

new ideas for other measurements or features that may occur afterwards, that may be implemented and included on the source code.

5. Decline

Retirement & Disposal

There may come a time where our system becomes useless either because it's old and it's cheaper to create a new one, there are new requirements that are not possible to satisfy with the current system, among others, and it will be necessary to replace with a new one. In this case, the system may be disposed as appropriate and a design for a new system will be necessary.



Fig. 2: WinTel Global View Flowchart

III. System Operating Flowchart

The system operating flowchart shows the sequence of steps to accomplish the WindTel project functionalities. It is divided in a subset of flowcharts. Each of these represent a subroutine in the system that performs a specific task. Fig. 2 represent an overview of the system initialization where the execute option subroutine step represent any subroutine explicitly shown from Fig. 3 to Fig. 10. The subroutines in the system are the following: start wind tunnel, reset, calibration, shutdown, acquire data, data visualization, logs and diagnostics.

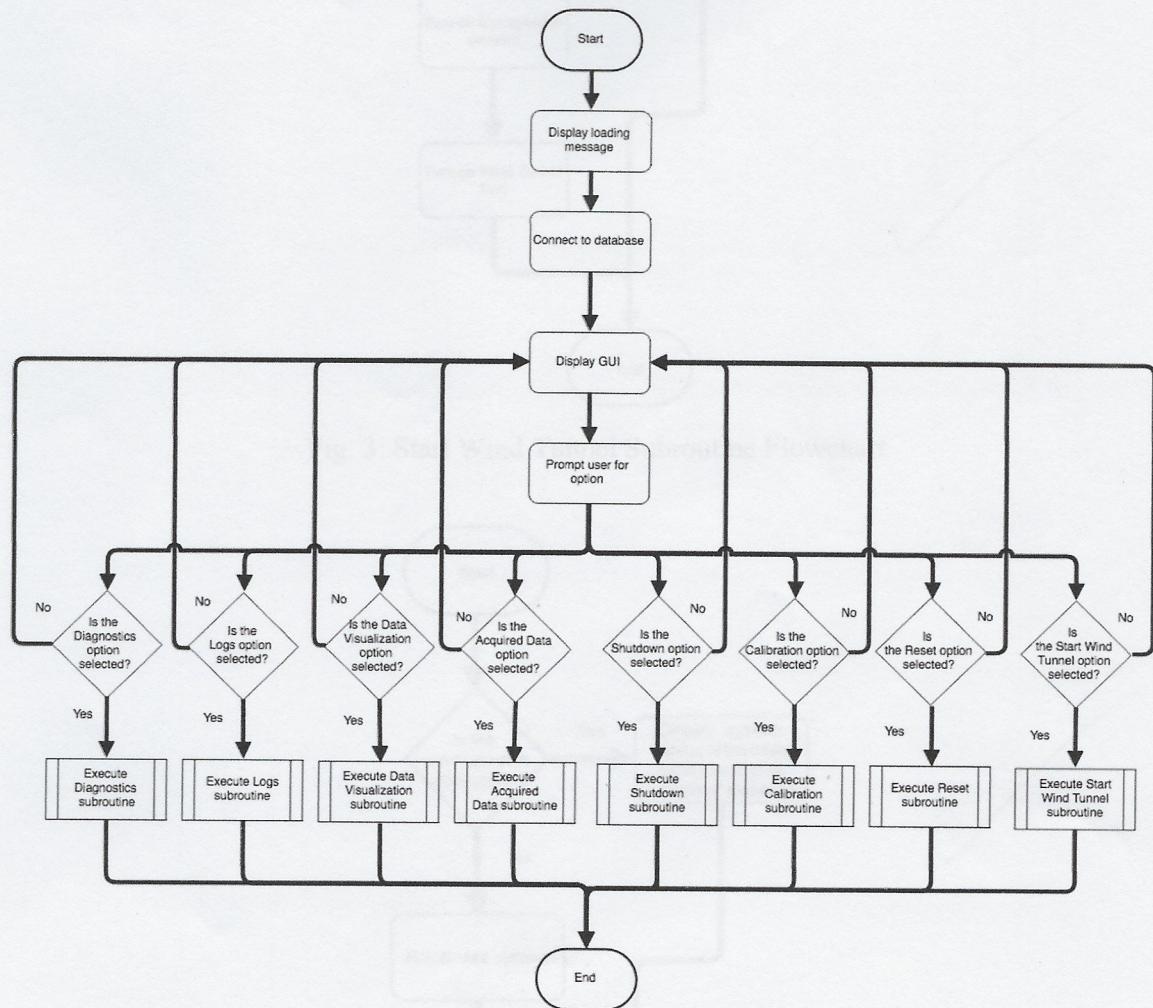


Fig. 2: WindTel Global View Flowchart

Make SCD
for System

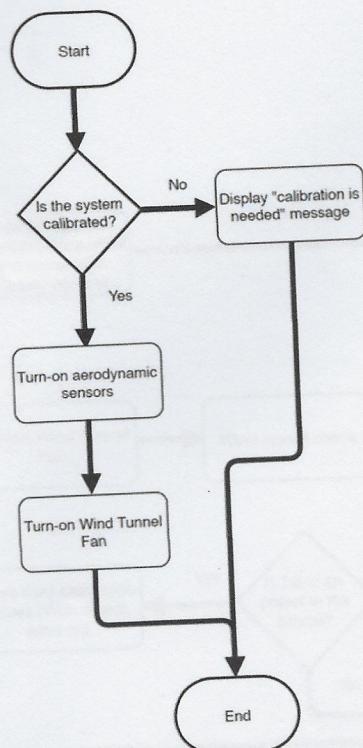


Fig. 3: Start Wind Tunnel Subroutine Flowchart

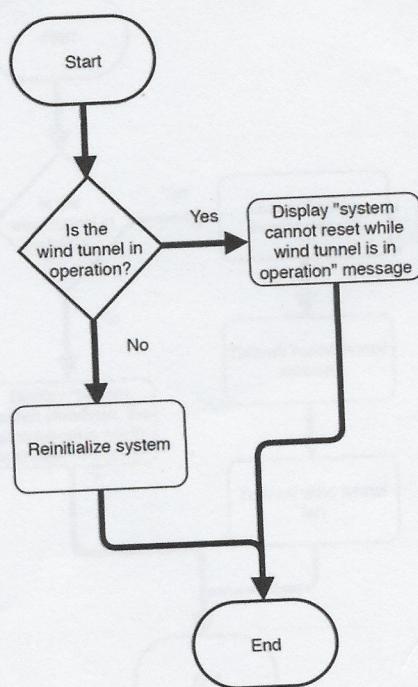


Fig. 4: Reset Subroutine Flowchart

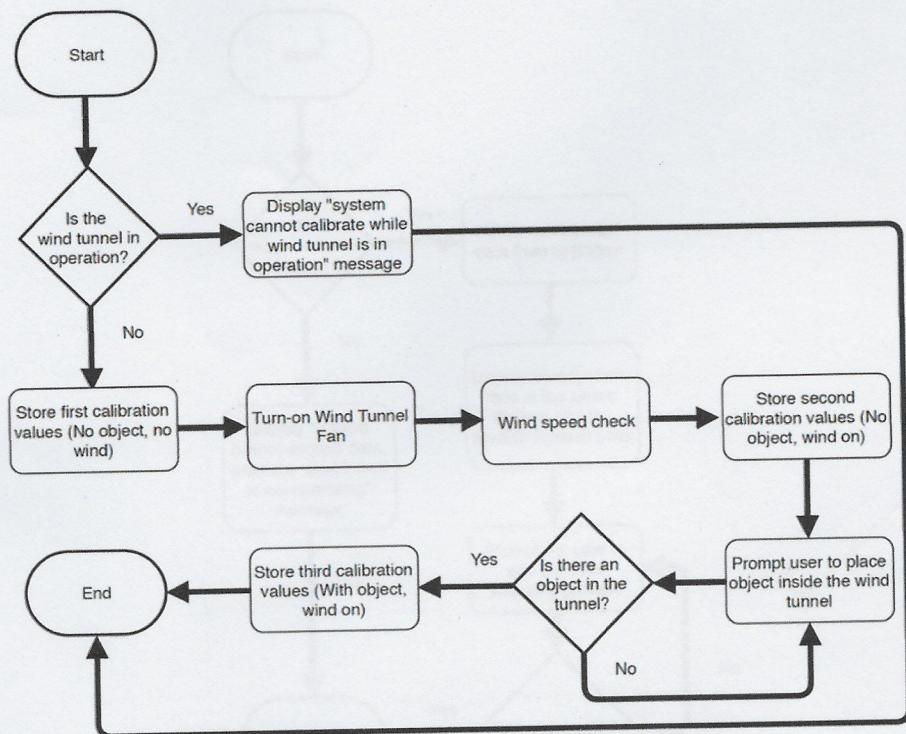


Fig. 5: Calibration Subroutine Flowchart

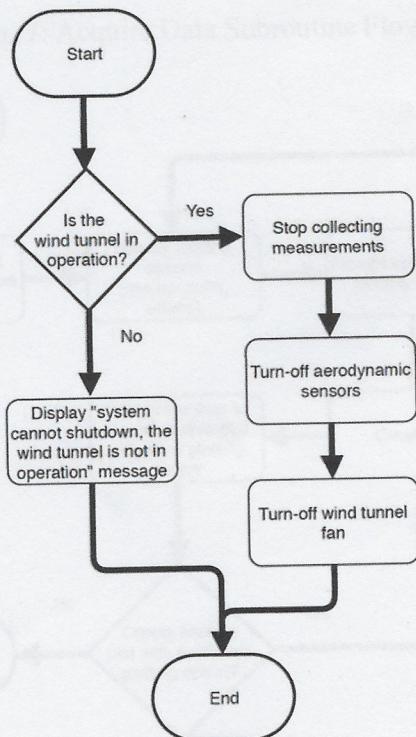


Fig. 6: Shutdown Subroutine Flowchart

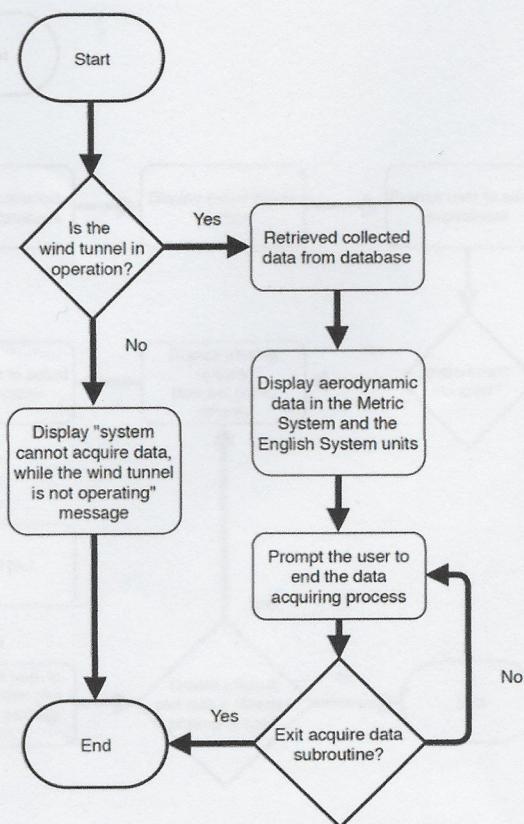


Fig. 7: Acquire Data Subroutine Flowchart

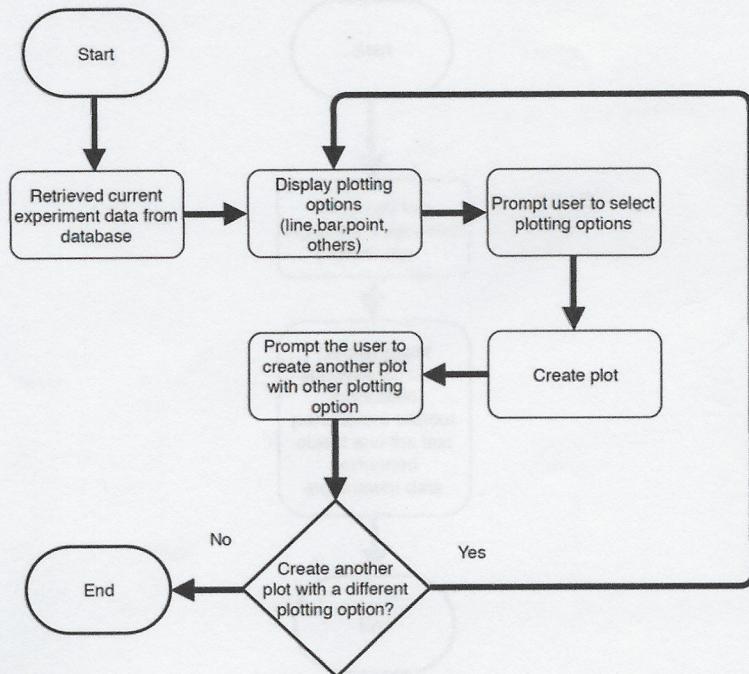


Fig. 8: Data Visualization Subroutine Flowchart

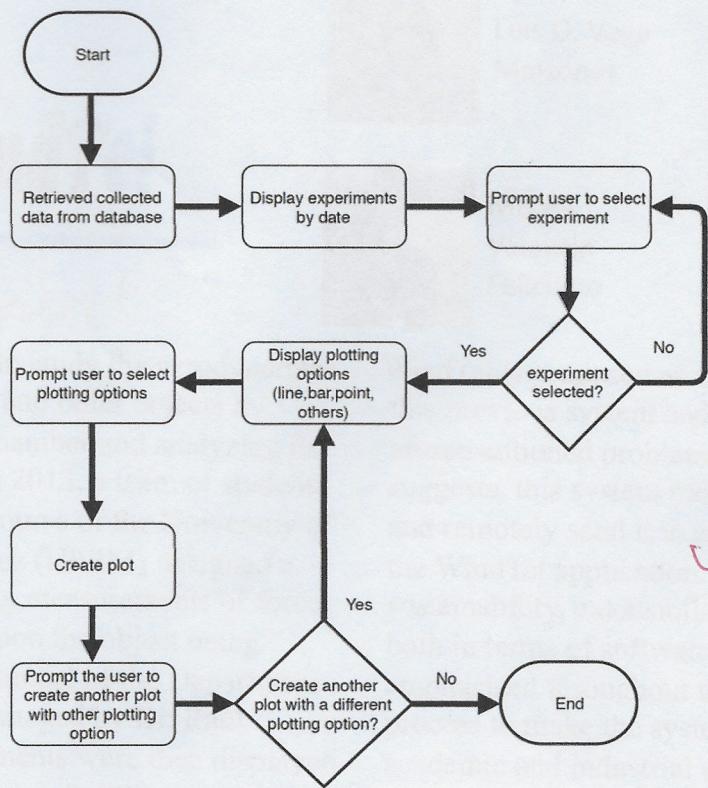


Fig. 9: Logs Subroutine Flowchart

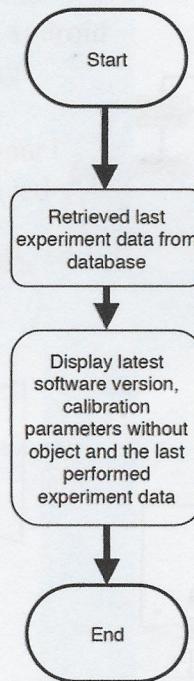


Fig. 10: Diagnostics Subroutine Flowchart