

# TMU Engineering Day 2024 POSTER SPECIFICATIONS

## Format

Poster dimensions: 24" wide x 36" high, PORTRAIT format only.

**Poster must be printed or mounted on POSTER board aka “foam core” (i.e. not regular paper) so that it can stand on an easel.**

### Voice Synthesized Check List and Vital Systems Monitor

James Koch

#### Motivation

Every year there are over 100 accidents involving Canadian registered private airplanes, some accidents resulted in fatalities. In many accidents engine failure was the cause. The rest were from something as simple as missing an item on a check list, such as “Check gear down and locked”.

Light aircraft lack the sophisticated avionics of jet airliners. Adding a small computer which monitors the engine system and flight controls, can improve the safety of operation. Having a spoken and visual check list makes sure the pilot and aircraft are ready for each stage of flight.

The goal of this project was to create a safer flying environment through the use of a spoken check list and automated monitoring of aircraft systems. The talking check list will ensure that the pilot completes the check lists without missing a vital step. Monitoring of the aircraft systems will provide an early warning that there is a problem with the aircraft allowing the pilot to take early action.




Figure 1: Light aircraft accident. Engine failure due to carburetor icing.

#### Approach

This system was intended to be installed in a Zenair CH250 a single engine 2 seat, home built aircraft. The instrument panel includes gauges for the digital fuel level, oil pressure, engine temperature and carburetor temperature. These need to be monitored by the computer for each stage of operation.

To add safety the canopy lock, nose wheel lock, and flap angle need to be monitored by the computer for confirmation of position. An input device is required for the human interface to the computer functions.

The systems and controls that need to be monitored were defined, then the method of monitoring was specified.

Rail Level, Oil Pressure, Engine Temperature, Carburetor Temperature, These require sensors and analog to digital conversion inputs to the computer. Canopy Lock, Nose Wheel Lock, Flap Position, Airspeed. These require digital inputs to the computer.

A video system to display the check lists, monitored inputs and warnings. An audio system to play back the check lists and issue warnings.

#### Testing




Figure 7: Getting ready for takeoff.

A mock up of the cockpit was created so that simulated flights could be conducted. Pilots were asked to go through the check lists, simulated system failures were also introduced to see the reaction of the pilots.

Comments of the pilots were positive, they liked the spoken check list idea as it let them know they did not miss a step. Early warnings of a possible engine failure allowed the pilots time to react sooner and allowed them time to plan an emergency landing or correct the problem.

#### Conclusions

Any device that improves the safety of flying, save lives and prevents accidents is a welcome addition to the cockpit.

The spoken check list which requires the pilot to acknowledge each item with a button press ensures that no item is missed.

Having an early warning that something might be going wrong with the engine gives the pilot more time to react and possibly prevent a forced landing.

Knowing the position of the flaps, that the canopy is secured and the nose wheel is properly locked for flight adds to the operational safety of the aircraft.

#### References and Acknowledgments

I would like to thank, Professor Mike Korman, Tim Pitts Ken Baker, George Welch.

<http://www.csb.gc.ca/en/statistics/2012/newsroom/2015.pdf>  
<http://www.challenger.ca/qaec/acident-study/>

#### Fabrication

Fabrication of the system involved wire wrapping a MICRO mini-computer system, with memory, I/O ports, digital I/O and printed circuit card slots. A circuit board was designed for the analog to digital converter, which interfaced to the thermocouple transducers, fuel level and oil pressure sensors. The speech synthesizer was hand wired on a prototype card. The video card was purchased as a kit and assembled.




Figure 2: Main computer board and interface cards.




Figure 3: Speech Synthesizer Board.




Figure 5: Analog to digital interface with Thermocouple amplifiers.




Figure 4: Video Interface and Monitor.




Figure 6: Digital Input interface.

## Content

Poster must contain the following key information:

1. Title of the project
2. Names of the authors
3. Motivation: Brief outline of the motivation for your project
4. Your approach: Detail your approaches using text, figures, tables, charts
5. Conclusion: Highlight your contributions and findings of the research

## Hints and Tips

Reference: There are posters from 2017, 2018, 2019 on the 3rd floor of the ENG building that you can use as references in designing your posters.

If you are including pictures try and use ones with as high a resolution as possible otherwise they will look very pixelated when blown-up to poster size.

If you are going to include the TMU Logo on your poster please follow the guideline found at [TMU Brand](#)

Sample Template:

[24" x 36" Poster Template](#)

Make sure your poster is the correct size and pictures look good.

View the PDF on a widescreen monitor - the bigger the better.

Open the pdf with Adobe Reader. Check "file / properties" and check that your poster is 24" x 36".

Zoom to 100%.

Scroll around and check the images.