U N I V E R S I T Y O F C A P E T O W N

Department of Electrical Engineering

EEE3000X – Vac Work Report

RADAR VISION

Songezo Kenene (KNNSON002)

March, 2021

(a) the objective:
To work on a device that automatically counts and uploads, for easy viewing, the amount of liquid (litres) that has passed through a certain point.

(b) the description of the equipment and principles involved

1. Soldering (mostly surface mount soldering).
   The equipment used:
   - Soldering iron
   - Solder
   - Flux
   - Hot air gun/Heat gun
   - PCB
   - Solder wick
2. Testing Connections and pins
   - Multimetre
   - Oscilloscope
3. Modules/chips to be used in the project
   - Silicon Labs Blue Gecko: EFR32BG13P and EFR32BG1P
   - Quectel Wireless module: M66
4. Software
   - Simplicity studio(IDE)
   - QNavigator
   - RealTerm
5. Some experience I brought to the work place, that was needed for the project:
   - I am comfortable coding with C
   - Soldering through hole components
   - Reading datasheets
   - Using UART communication
   - Working with microcontrollers (e.g STM32F in EEE2046F)

(c) the implementation

The first step was learning to work with the M66 modem. Did this using the GSM EVB Kit – Standard kit from Quectel. Learning how communicate with it using AT commands. To do this I used QNavigator and some documentation available online.

Then I worked with the EFR32BG1P on a standard kit (EFR32BG Bluetooth Smart Starter Kit) to learn working with the EFR32BG family of chips.

After working with them separately, the M66 modem and the Bluetooth chip, I used them on a custom board. The type of on board communication is UART. This custom board is for receiving the count (number of litres) via Bluetooth and submitting it to an online server using the M66.

To program/ work on the custom board I used the EFR32BG Bluetooth Smart Starter Kit in debug mode: OUT, that allow for communication/debugging of an external chip instead of the onboard one. The set up can be seen in picture5 in the gallery

For testing I used a button to simulate the liquid flow (for simplification) with a bluetooth chip (with fewer pins) on a different board. The final product uses a Reed switch. This board then broadcasts the count, which is then picked up by the custom board mentioned above.

(d) the results obtained

I submitted the working project code and the hardware to the company.
Things I learnt from the work:

- Working with a new IDE: Simplicity Studio
- Soldering surface mount components
- Working with modems
- Working with Bluetooth microcontrollers

(e) the conclusions

The project was a success from my side. I managed to finish all the work I was assigned and submit a working source code. I learnt about the process of creating a product more specifically embedded systems. Creating a design from a schematic to PCB, putting everything together and then implementing the software. All this with a lot of testing/debugging in between. Also learnt about the prototyping and simulating part and how simplifying the hardware helps during the development process.

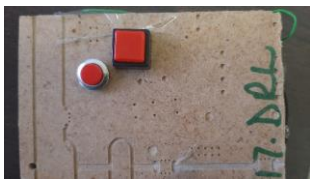
Below are the pictures

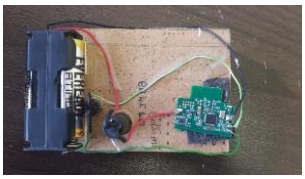
An example of a liquid flow measuring device that I am implementing the solution for:

The EFR32BG Bluetooth Smart Starter Kit and GSM EVB Kit

Tag-connect: for connecting custom board to the programming computer via the Silicon labs starter kit.

The board that implements the count using the magnetic switch (reed switch) and broadcasts it:





Working stations and main setup for programming the custom board.