4B25 Project, Report 5. Medication Tracker

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I. The Problem

A major symptom of growing older is short term memory loss. This can lead to issues for those living alone, for example forgetting to take medication. This project aims to tackle this issue. By attaching passive RFID tags to pill boxes and inserting an RFID tag reader into a wearable system, the patient can track what pills they have taken.

II. Stakeholders

This device can help elderly patients as well family and carers. Local councils may also be interested in this technology as it may enhance their social care.

III. State of the Art

There are solutions in the market for this problem, like Pill organisers. There are more electronic solutions like [1]. This is device displays time and alarms when it is medication time. The device battery is said to last 24 hours. This project aims on improving the device by adding the RFID tag system to record medication. RFID systems have become low cost and highly functional. Whilst they can be used for communications, this project only needs a low power tagging system Part of this project uses an OLED display. The display can be compared with an LCD. LCDs consume less power but are not as effective in daylight conditions. OLED is chosen to increase the display's effectiveness.

IV. Project Approach

The device was designed for notifying the user when medication time and recording the user taking the pill. A Real Time Clock (RTC) and display is used for the former and the RFID tag for the latter.

Driver files have been created to run this devices. They are adapted from existing libraries to use with the warp firmware. More information can be found on the Github repository.

The main code is in the file mainProg.c The outline of the code is presented in Fig 1. The code currently uses set alarm times and medication names. The code could be expanded to allow the names and times to be user re-writable using non-volatile memory.

The wiring schematic is show in Fig 2. The RC522 and SSS1331 both use SPI whilst the RTC uses the I2C interface. The INA219 is also shown connected to an Arduino to measure and record the power consumption.

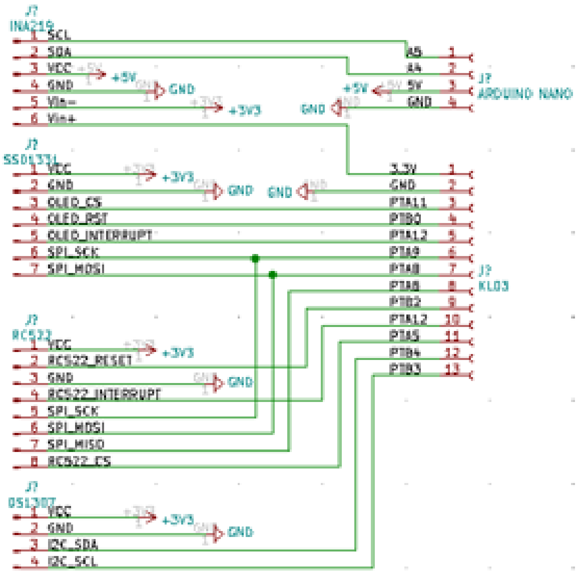

Fig. 1. Wiring of the system

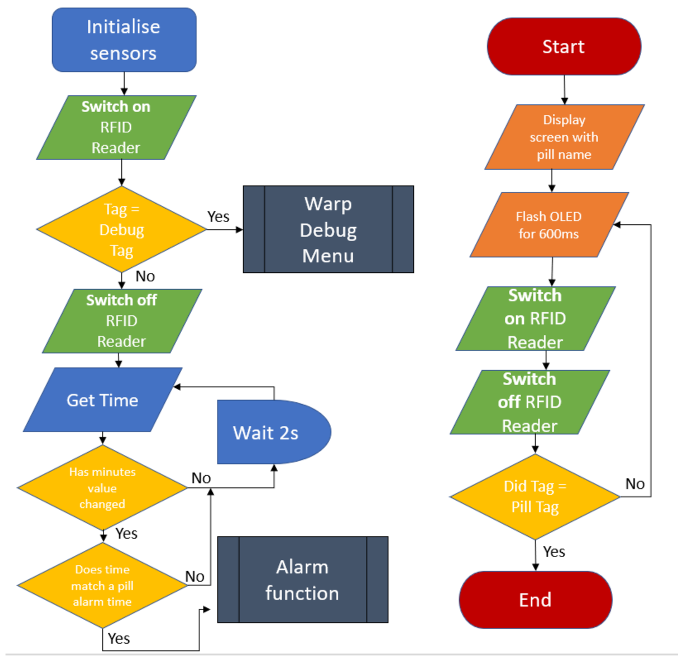

Fig. 2. Flowchart shows how the main algorithm for the medication tracker works

V. Power Consumption

Power consumption was chosen as the metric of performance as the device is intended to be battery operated.

Steps have been taken to reduce power consumption by altering what was displayed on the OLED. The OLED had two states: displaying time only and flashing for alarm state. Displaying only green subpixels reduced consumption as the eye is most sensitive to green. This reduction is shown in Figure 4. By reducing the overall brightness per pixel, the time only power consumption dropped. The brightness was still high in alarm state as the display needs to draw attention. The large error bars are due to the pixels turning on/off when flashing.

The RFID sensor originally consumed 80mW after it had been switched on (Scenario 1). To reduce the consumption the sensor was reset after a read operation and the power drops to 6.6mW (Scenario 2). During alarm state the tag must be on to read. So, to save power the sensor is reset and initialised periodically, reducing the average consumption (Scenario 3). The device was put into low power mode instead of resetting. The consumption was slightly less in time only (Scenario 4) and as they were not need for re initialization (register retained memory) the time the sensor was on reduced and hence consumption (Scenario 5). The large error bars are due to the sensor turning on/off.

Fig. 3. How the OLED looks like in different modes

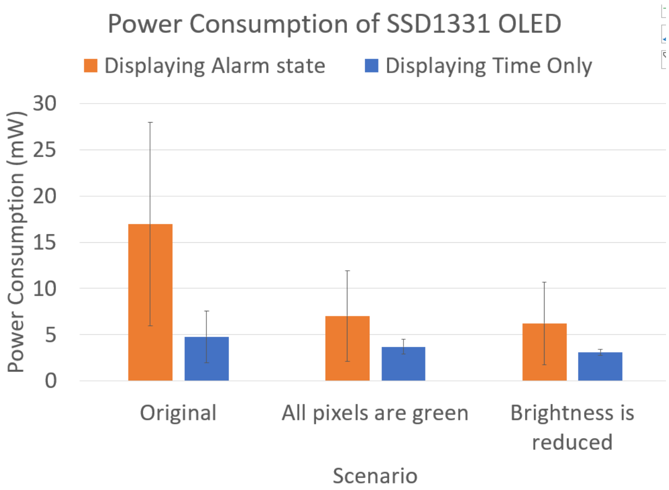

Fig. 4. Power consumption of the OLED

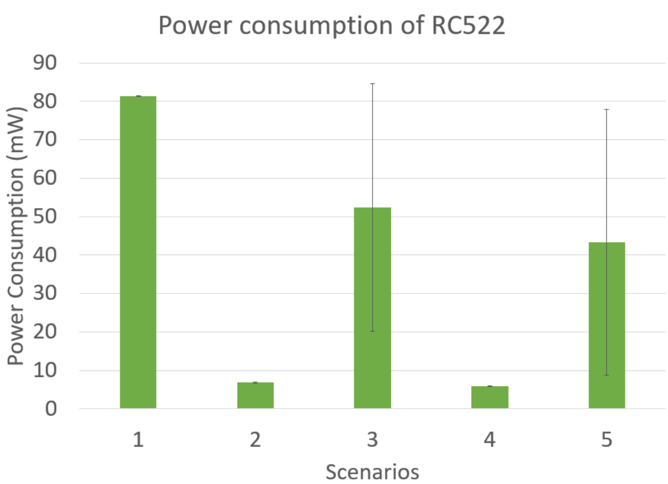

Fig. 5. Power consumption of the RFID Reader

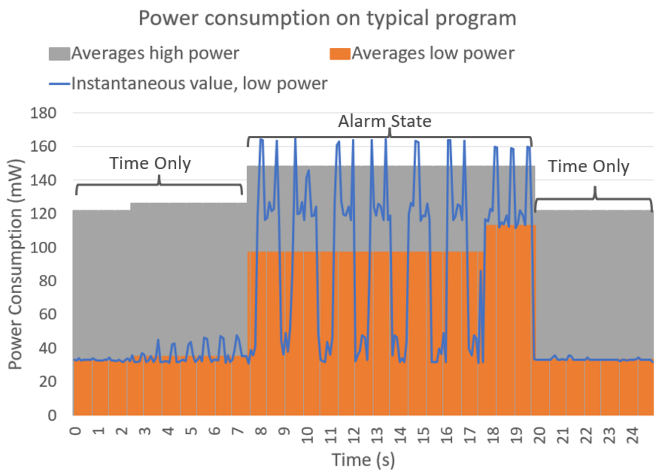

Fig. 6. Power consumption of system in typical cycle

The consumption of the RTC was stable at 2.3mA through operation.

The current consumption of the device in low power operation is shown Fig 3. The reduction in power is noticeable from grey to orange. The pulses in alarm mode are related to the flashing screen. If a Samsung Galaxy Watch battery is used (360mAh 5V) the device will last 50 hours or 2 days. (Assuming the alarm rings 6 times a day for ten minutes.)

References

[1] 8. Amazon. Amazon.co.uk. https://www.amazon.co.uk/TabTime-Vibrating-Alarm-Reminder-Watch/dp/B0855ZMGLN/. Published 2022. Accessed January 27, 2022.

[2] 9. Kozuch K. Samsung Galaxy Watch 4 review. Tom's Guide. https://www.tomsguide.com/uk/reviews/samsung-galaxy-watch-4. Published 2022. Accessed January 27, 2022.