

Need Statement

- Chronic lung conditions and diseases affect about 545 million people worldwide [1]
- Patients with conditions such as COPD and cystic fibrosis, benefit from breathing exercises by clearing their airways of excess secretions to prevent infections [2]
- Many patients (significant <16 years olds) reported difficulty in adhering to the treatments, with cited reasons including a lack of interest, motivation, and time [3]

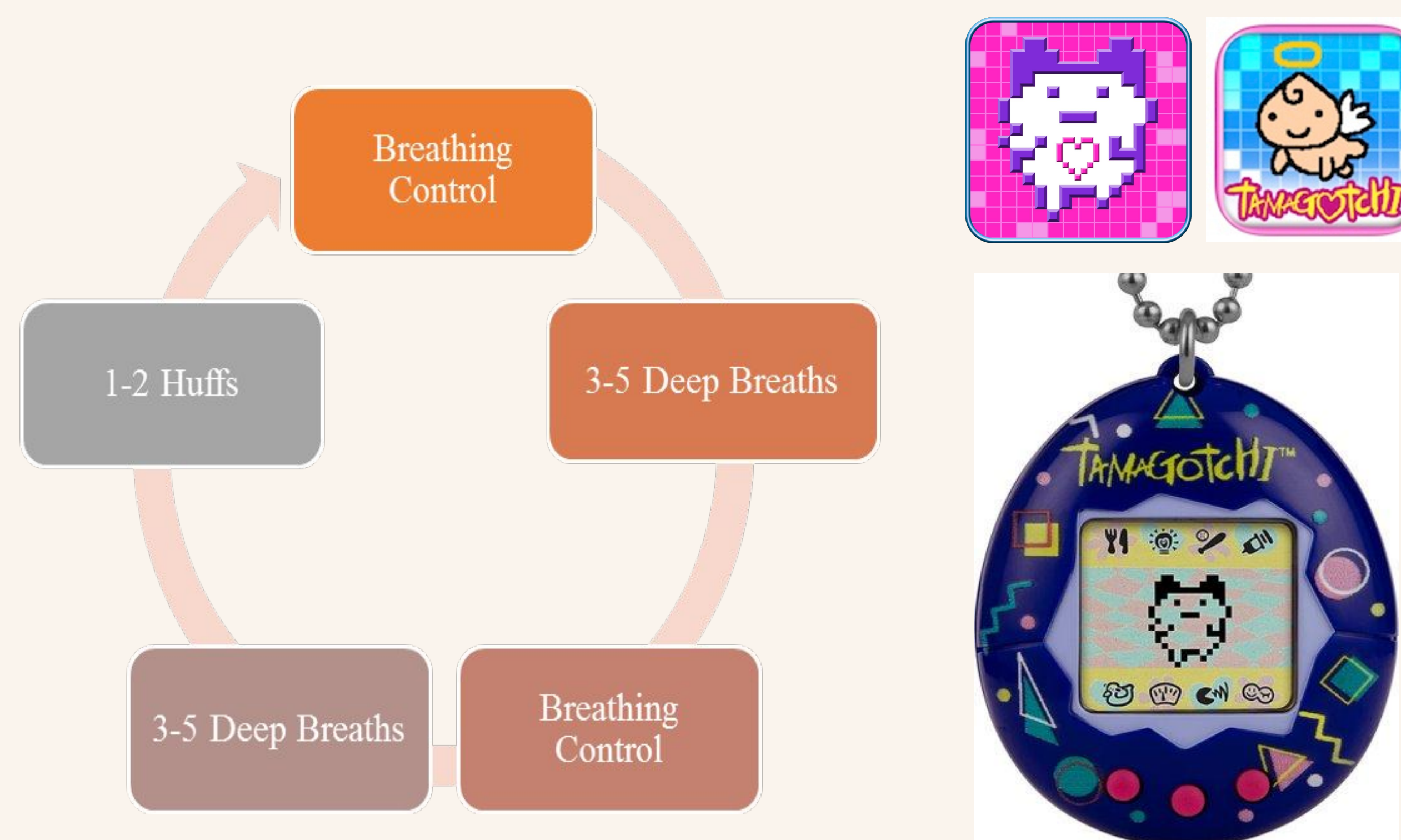


Figure 1. Active Cycle Breathing Technique Used for COPD [4]

Design Criteria

Objective: to create a device and app to encourage adherence to breathing exercises through positive reinforcement

- ★ Portable, Enjoyable, Real-time feedback

Breathing Game Needs	Design Requirements
01 Ability to guide one 10 minute cycle of Active Cycle of Breathing Technique	<ul style="list-style-type: none"> • Calibration of user lung capacity parameters • Stages for each component of cycle, with defined thresholds for passing each
02 Social component	<ul style="list-style-type: none"> • Creation of a networking system that motivates users to keep up
03 Accessible for patients	<ul style="list-style-type: none"> • >\$30 dollars (App + Hardware) • Portable • Intuitive to use
04 Interactive components	<ul style="list-style-type: none"> • 3 or more interactive elements outside of breathing exercise guidance
05 Seamless hardware-software integration	<ul style="list-style-type: none"> • Less than 2 seconds of input delay

Figure 2. Needs and Requirements for our Design

UX Prototype

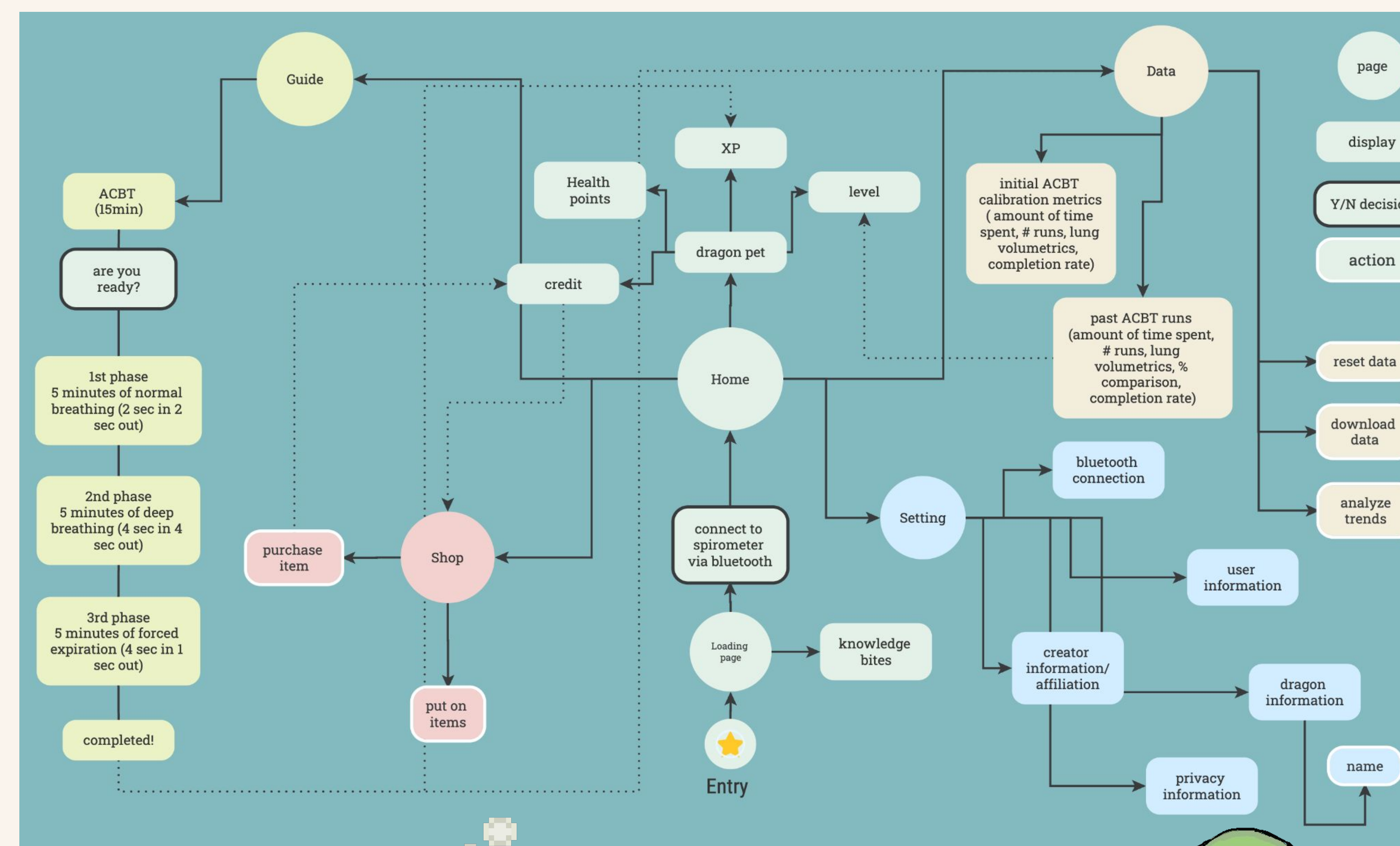
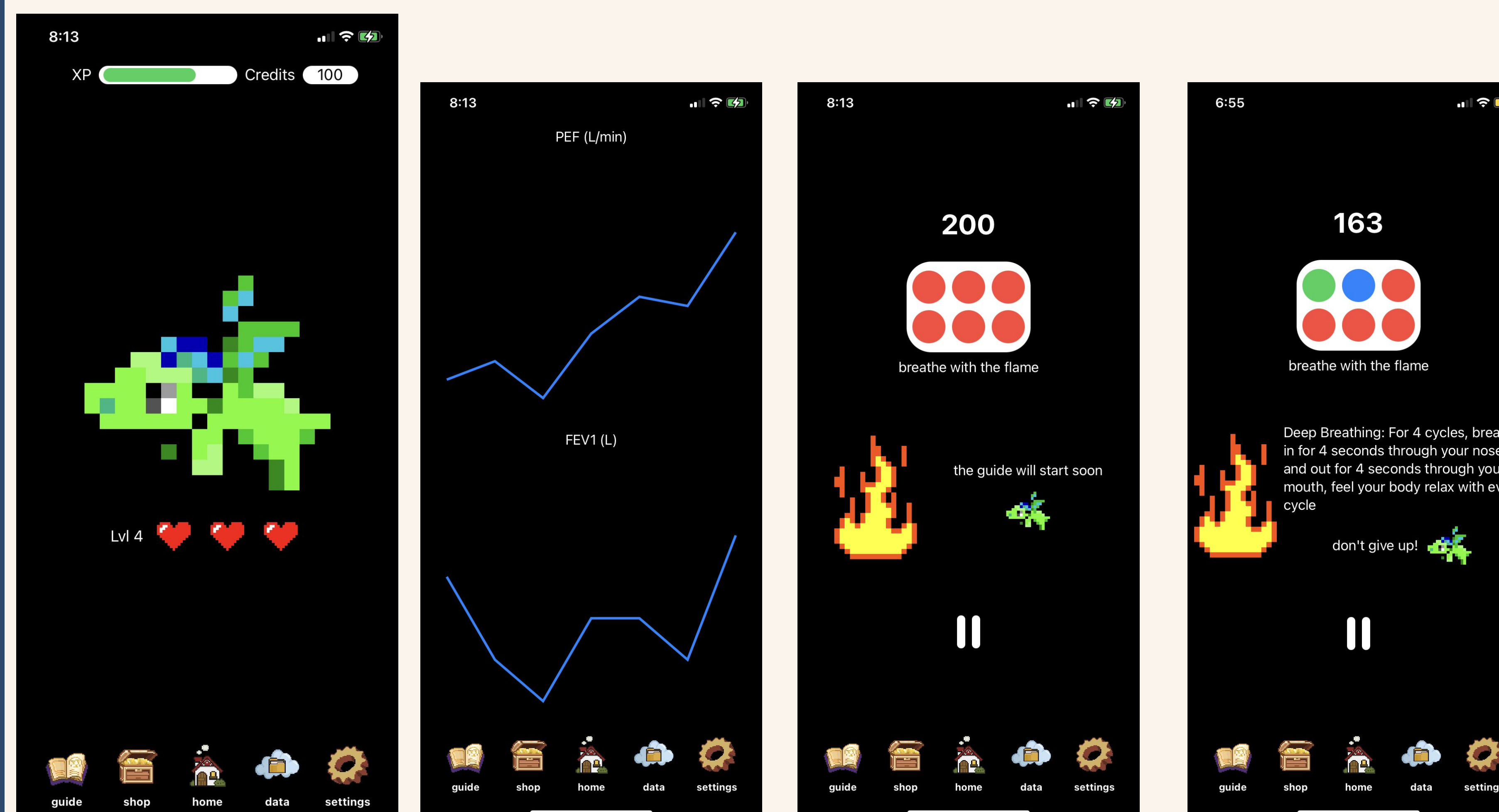


Figure 3. User Flow



Figure 4. 8-bit icons made from scratch

UI Prototype



Figures 5 - 8 (L - R). Screenshots of the app interface (home page, data page, guide page upon starting, guide page during second phase)

Standards

- §7.8.I.1 of the IEEE Code of Ethics, Maintaining Privacy
- FDA Class I device, low risk of illness or injury and is largely based upon existing and noninvasive technology
- Health app
- §2.1.4 BMES Code of Ethics, consulted relevant resources

Testing Information

Preliminary: ensuring correct HealthKit outputs from spirometer

- ✓ Correspond to both an increase in XP and an increase in credits (given it is a reading at the end of a 4 day streak)
- ✓ Failing to complete a reading and exercise in a day will result in loss of a heart, so a test was done to ensure this occurred
- ✓ Loss of all three hearts resets XP, levels and credits

Future Direction

- Successful bluetooth integration
- Inclusion of audio designs to enhance enjoyability and user experience
- Further work on animation and graphics
- Development of low-cost spirometer prototype with ability to accurately measure airflow and send data via bluetooth
- Testing of end product in target demographic

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References

- [1] Labaki, W. W. et al. The Lancet Respiratory Medicine, 8(6), 531–533.
- [2] Lewis, L. K. et al. Respiratory Medicine, 106(2), 155–172.
- [3] Santuzzi, C. H. et al. Pediatric Pulmonology, 55(10), 2646–2652.
- [4] Respiratory physiotherapy. Physiopedia. (n.d.).