



# CareBit: A Privacy-Preserving Step toward Remote Family Caregiving



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## Introduction

Family members often care take loved ones as in-home patients, requiring constant attention that creates significant caregiver burden. For instance, family members are forced to decide whether they should go to the grocery store and risk leaving an elderly or special needs family member at risk.

- While monitoring systems exist for patients to self-monitor or to enhance communication with one's doctors, such systems are often privacy-invasive [1]. Also, they use specialized hardware that the patient does not want to wear and is cost prohibitive.
- Therefore, current solutions do not readily meet the needs of in-home family caregivers.

Thus, we propose **CareBit**. CareBit gives patients the flexibility to choose what details are shared with their family caregiver, while still giving enough information to monitor daily activity levels for adverse events. CareBit uses risk thresholds based on heart rate and steps to send notifications to the caregiver in the event of an emergency, so they can check on their loved one.

## Methods

### Designing CareBit

- The FitBit connects to the patients' phone via Bluetooth, and automatically syncs to the FitBit server once every 15 minutes.
- CareBit requests data from the FitBit servers once every 15 minutes, and parses the data into different objects
- CareBit then checks for medical problems by seeing if heart rate and footsteps rise above or below a threshold.
- If a threshold is broken, a notification is sent to the caretaker, which informs them of a possible emergency, and to contact their patient.

### Designing the User Study

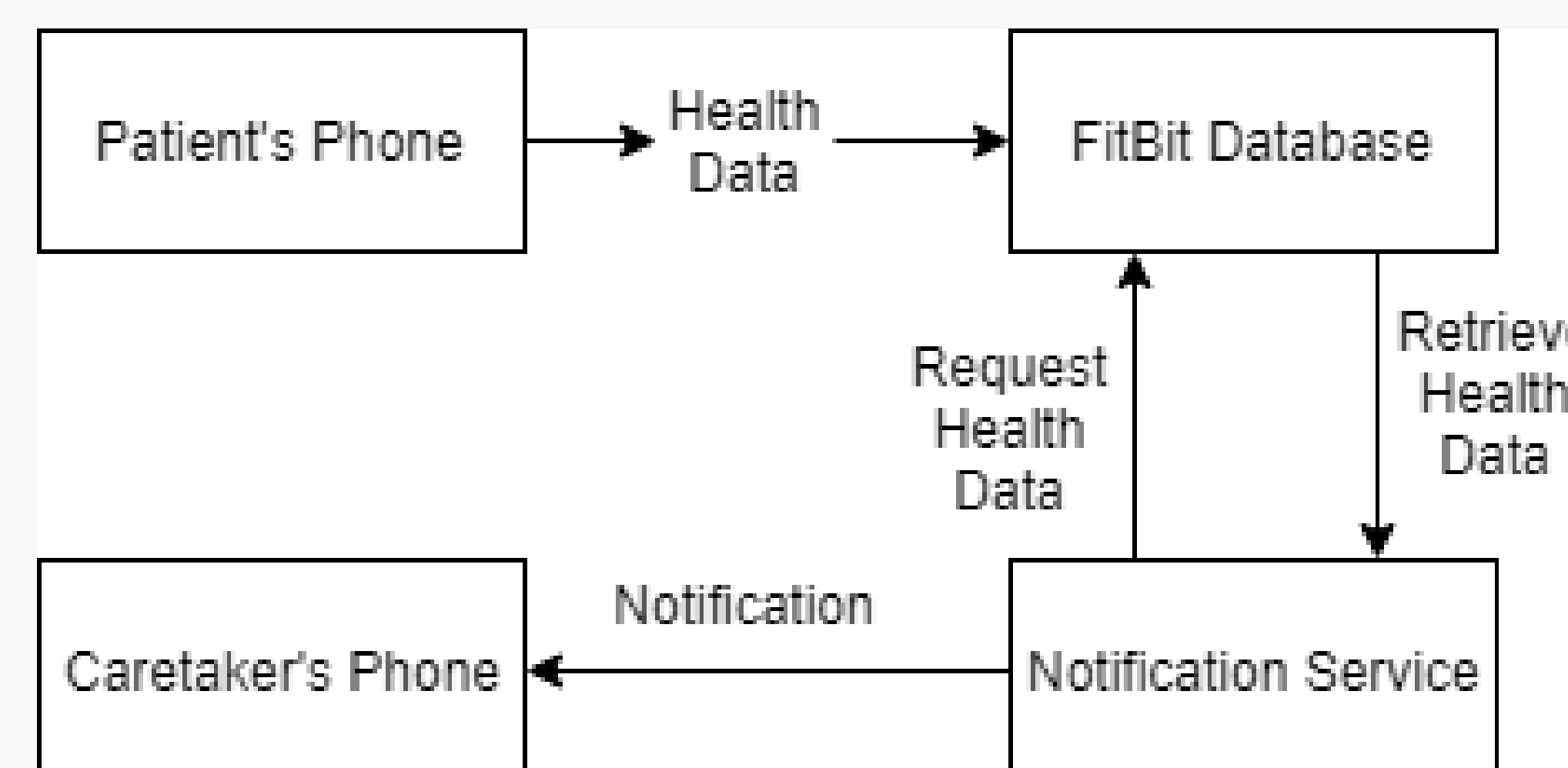
- We asked 5 volunteers to act as the caretaker in our study.
- The first author of the poster acted as the patient, and would artificially raise our heart rate or cause an overactivity alert.
  - When causing an alert, we recorded the time the alert to be sent, and when the response was received.
  - We would also record any responses that were false positives, or an unintentional but accurate notifications.
- The volunteers were responsible for the following:
  - Wait for a notification to occur and then contact the patient asking if we are okay.
  - Periodically check the application to ensure our safety.
  - Complete a post study survey asking about the application and their experiences using the applications.

## Acknowledgements

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## Implementation of CareBit System

Figure 1: High Level Architecture

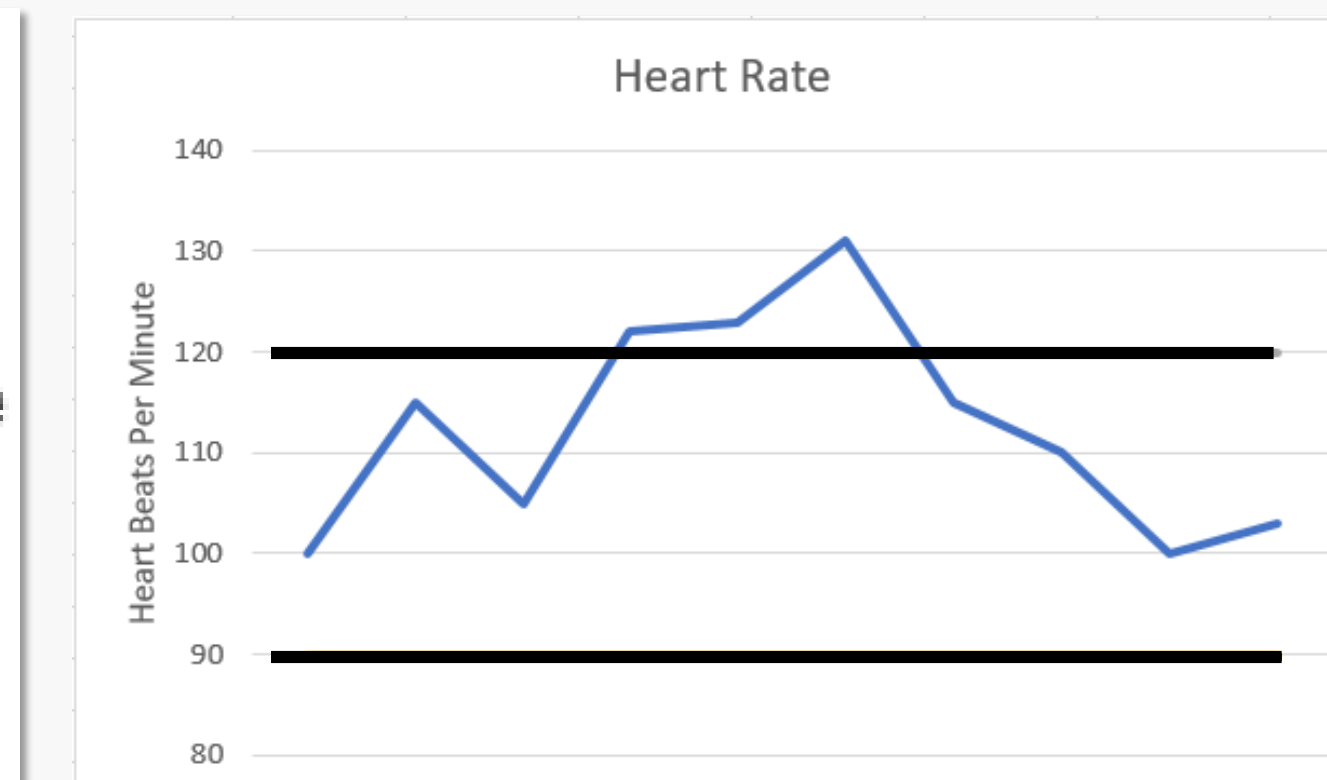


**Patient's Phone:** Fitbit synchronizes information on the Patient's phone every 15 minutes. This information is immediately sent to the FitBit database

**Notification Service:** A Secondary process runs in the background of the phone. It requests data from the FitBit database, and analyzes the data using a thresholding system from the User Preferences. If an alert is found, then it sends a notification to the caretaker's phone.

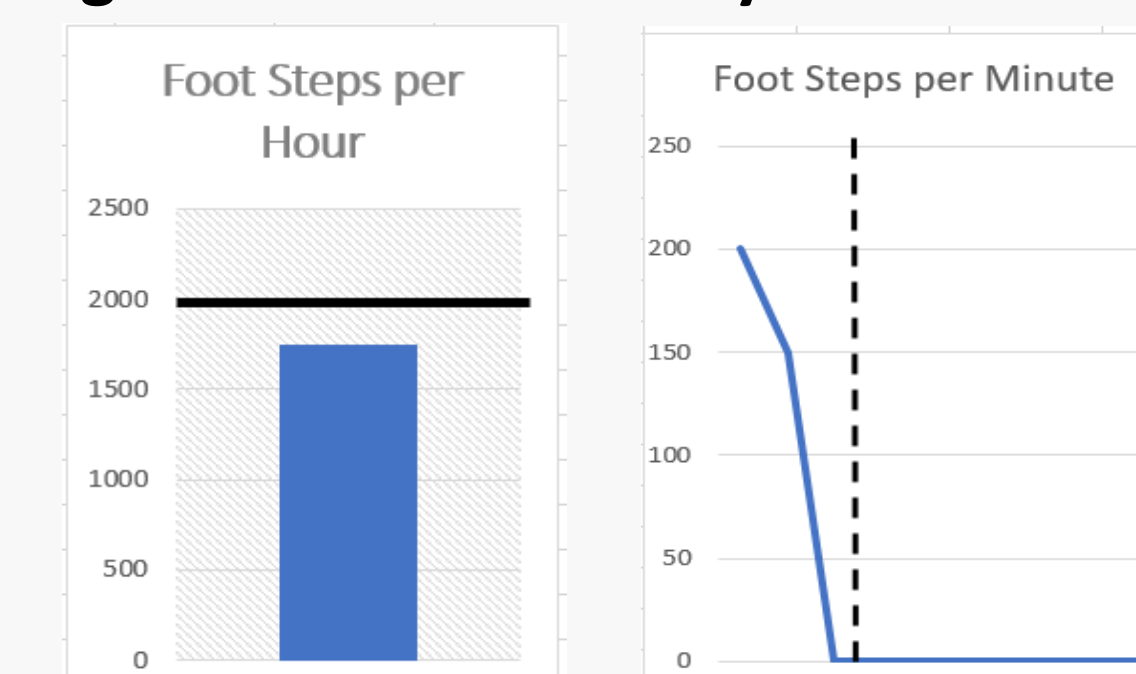
**Caretaker's Phone:** The Caretaker's phone displays the notification, and changes the Alert Bar on the dashboard.

Figure 2: Notification System – Heart Rate

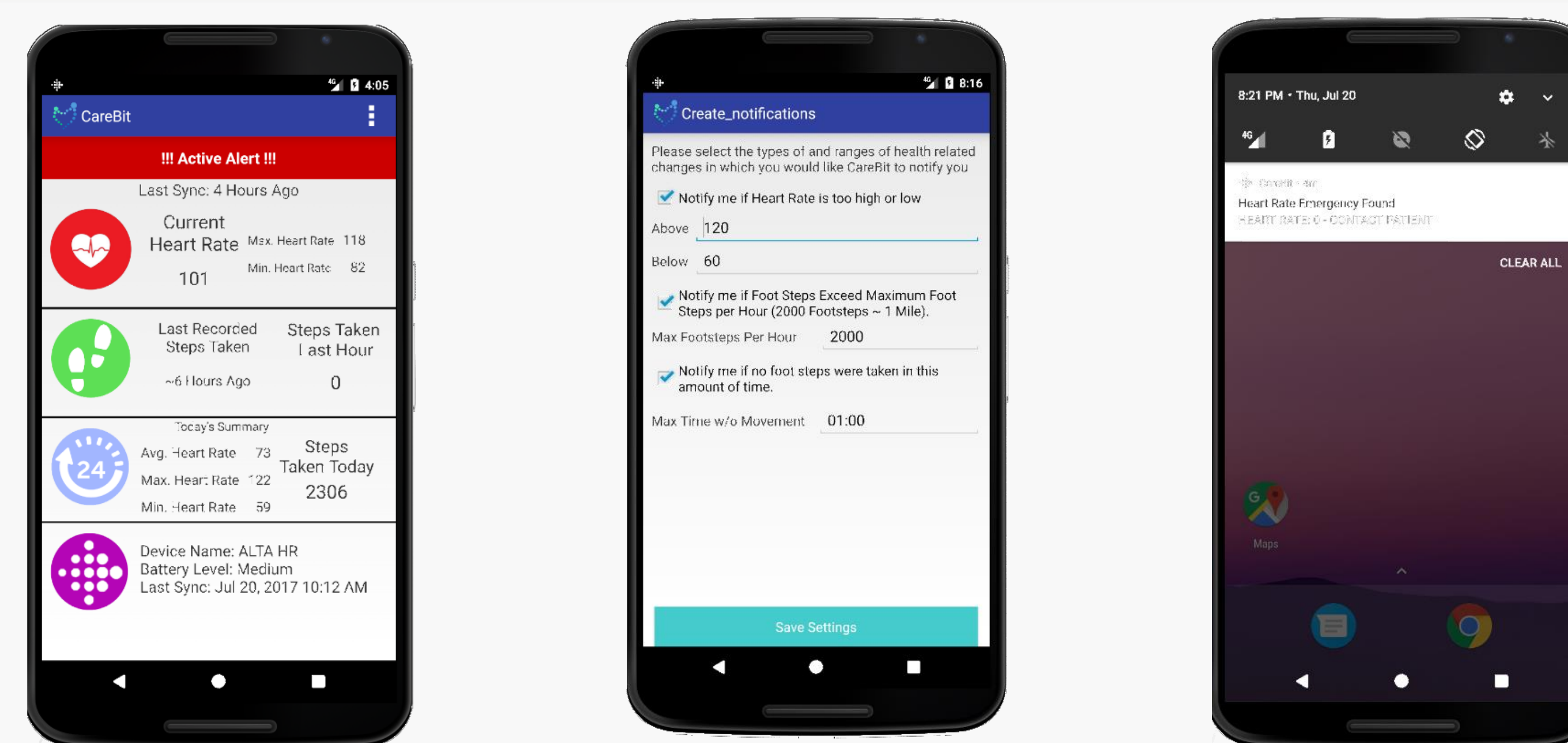


When the heart rate goes above or below the threshold, a notification is sent to the Caretaker's phone.

Figure 3: Notification System - Activity



## CareBit GUI and User Interface



Dashboard

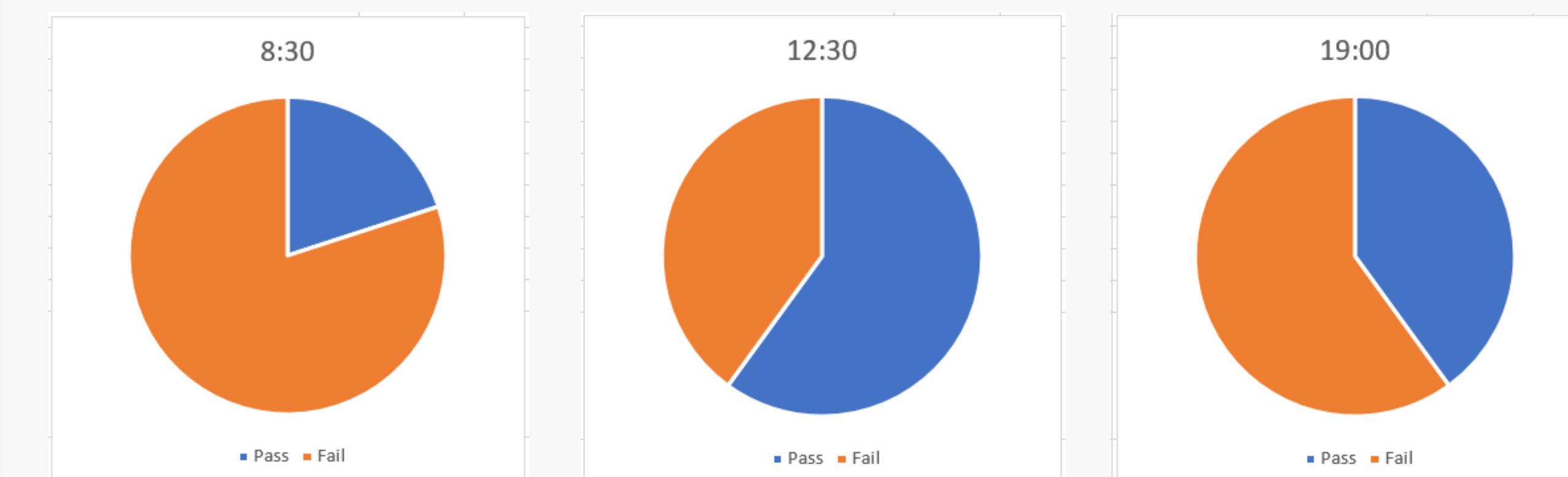
Notification Settings

Notification

- Dashboard:** This is the main screen of our application. This main menu includes:
  - Activity Alert:** States whether there is currently an alert being sent to the user. Clicking the alert bar automatically opens the messaging with the number of the patient.
  - Heart Rate:** The system displays the current, max, and minimum heart rate for over the last hour.
  - Foot Steps:** Gives footsteps over the last hour, and last footstep taken.
  - 24 Hour Summary:** Describes statistics over the course of the entire day
  - Devices:** Gives last device used for syncing data with FitBit database.
- Notification Settings:** Has threshold settings for heart rate and footsteps.
- Notification:** Example of a notification being sent from the notification service to the Caretaker's phone.

## Results

Figure 4: Feedback from Notification System



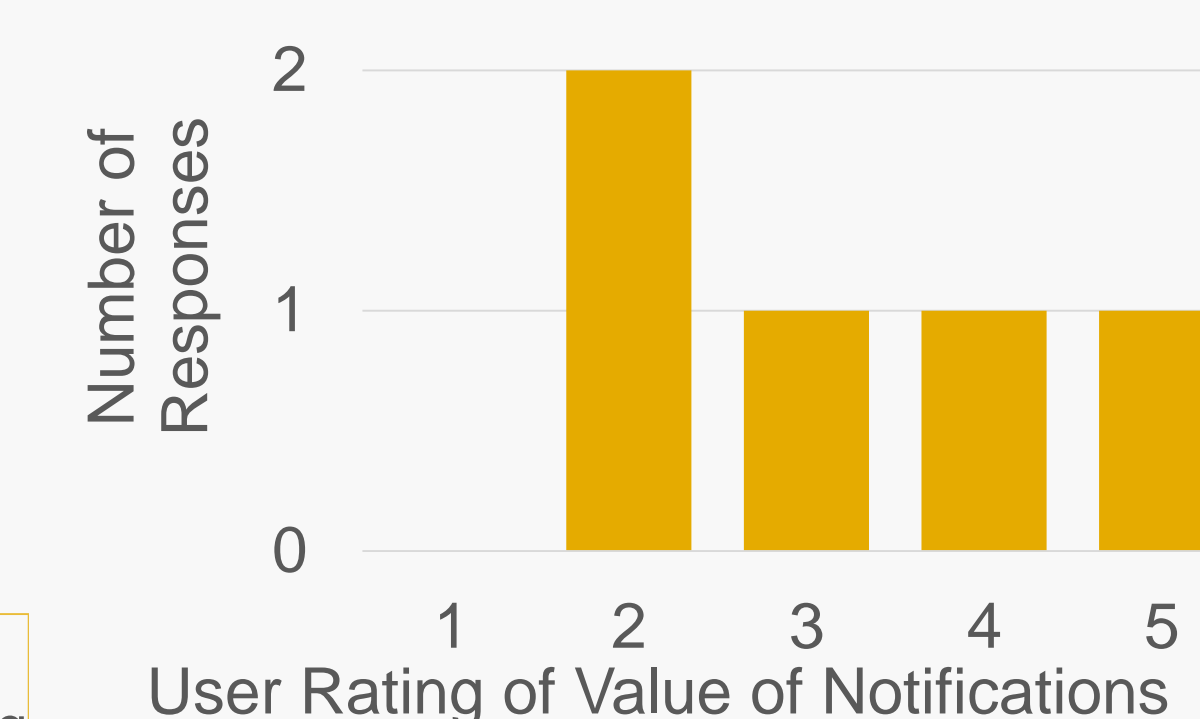
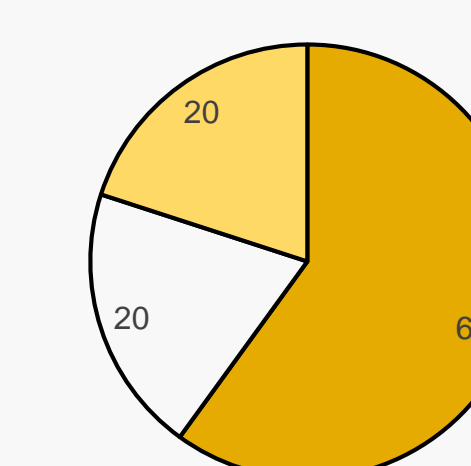
- "Pass" indicates that the volunteer received a notification and responded.
- On average, the volunteers had a 50% pass rate across three time periods

Figure 5: Average response time by User

	8:30	12:30	19:00
Average Response Time	35 Min.	25 min.	20 min.

### User Study Feedback

What was the most Useful Feature?



- Overall, 60% of participants stated the most useful feature was the notification system. 30% of Caretakers noted footsteps metric by itself is not adequate for displaying activity.
- None of the participants mentioned concerns for the patients' privacy.
- Caretakers gave mixed responses on the technical implementation of the notification system, some stating that the notification system gave a good indication of an alert, while other's stated it should vibrate for a longer period of time.

## Limitations and Future Work

- At this time, the user study served as a small pilot study of an early beta version of Carebit, which is still under development, to show promise toward a proof-of-concept for remote family caregiving using wearable IoT.
- Therefore, more user studies need to be completed before any conclusions can be drawn about the efficacy of our final solution.
- Additionally, in our future work, we plan to create a more sophisticated altering system and test it with real patients and family caregivers.
- The end goal is to provide a low-cost, privacy-preserving solution to meet the unique need for remote monitoring between family caregivers and their elderly or loved ones. Such solutions would support the patients' independent living and reduce the need for costly out-of-home care.

## References

- [1] Tan-Hsu Tan et al. 2014. Indoor activity monitoring system for elderly using RFID and Fitbit Flex wristband. *IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI)* (2014).