Crab Tracker Prototype

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Description of Project

The Crab Tracker app is designed to run on a raspberry pi 3b and aid in tracking the movement and logging environmental information for three aquatic crab species: dungeness, rock, and the European green crab. The user will use this app in two environments. First to do data entry when they trap and tag crabs with a sonic transmitter the user will input information (type, sex, etc.) about the crab along with the unique identifier (UID) of the transmitter being glued to the crab. The second way the app will be used is inside of a kayak to display information about the location of tagged crabs and record relevant information about them. While on the boat the raspberry pi will be connected to four underwater microphones, called hydrophones.. The hydrophones will pick up signals being broadcasted from the crab's transmitters. This information will be processed separately by the pi and then displayed by our GUI. The information available to the GUI is the UID of each crab, the crab's direction in relation to the kayak (as x and y coordinates), a rough approximation of the crab's distance from the kayak (0-10 meters, 11-100 meters, or 101+ meters), and whether the crab is alive or inert. There will be two different ways available for displaying the data. In both options the main screen will be a radar like display with the kayak at its center. The first display option will use arrows to display the direction of the crabs in relation to the kayak. If the user wishes to track specific crabs, only those arrows will show up on the display. The second display option will be a heat map that shows a rough estimation of population density in that region with darker colors indicating more crabs in that area. If the user chooses to track only specific crabs, these will show up as dots of different sizes on top of the radar display. The heat-map background can be turned off or on at will by toggling the mode button.

Feedback and Recommendations

Primarily feedback from classmates consisted of questions about portability, scalability, concerns about overwhelming amounts of information, and requests from the addition of some extra features.

- Due to the specialized hardware being designed by other teams working on this project the GUI will not be portable to other hardware platforms.
- We have addressed the issue of scalability by creating a setting that allowed the user to show only information for an individual crab that they are interested in. Additionally we added a second way to present the data, as a heatmap of the density, which will be useful as the information presented in this format will be far less overwhelming if hundreds of crabs are being shown on the small pi screen.

- To further reduce clutter on the screen we removed the words active and inert and instead used color to communicate the status of each crab.
- An extra feature that was recommended was an alternative method of identifying the crabs on the screen using nicknames. We have chosen to keep the UIDs but have added a feature that allows the user to simply select if they would like to see these UIDs on the screen.
- Additionally we have updated the icons to be more consistent with convention, and therefore user expectations, by replacing radial buttons with check boxes.

Overall design goals of our system

The overall design goals of this project aim to make the user's field work enjoyable and limit any frustrations associated with field work. Our overall design goals are a radar like main display which will rotate in relation to magnetic north and can display crab location data as arrows indicating their direction and a heat map indicating population density. We also want to have a method for data entry when crabs are being tagged, as well as a method for updating and adding to that data as crabs are later tracked and located in the field. As the speed of sound underwater is used to calculate a crab's location it is important that the GUI provide the ability for the user to update information about factors that affect these calculations, namely the salinity and temperature of the water and then communicate these back to a seperate program that makes these calculations. Finally we want to provide clear settings that allow the user to adjust what is shown on the screen so that only relevant information is being. Most critically there needs to be a way to easily export data that has been collected in the field to a csv file so that the user is assured that all of the data collected will not be lost. Overall we aim to make a self consistent system that has a unified look and feel that will be enjoyable to use during the physically demanding tasks associated with field work.

Design goals for the class project

For the class project we plan to attempt to fully implement two major features as well as the visuals for the rest of features so that the underlying functionality can be added later. The two major features we plan to implement are the radar like display which shows arrows to give the user an indication of the crab's direction and identifies the individual crab with a UID and the data entry functionality of the design. This will keep a history of all crabs and their environmental data when tracked down using our system as well as providing a way of keeping track of which crabs have been tagged. We do not plan to implement heatmap display, but will focus on the arrow functionality. For the part of the project created in class, we will be relying on simulated data about a crab's location, so that we are not dependent on the hardware being complete or functional.

Original Sketches

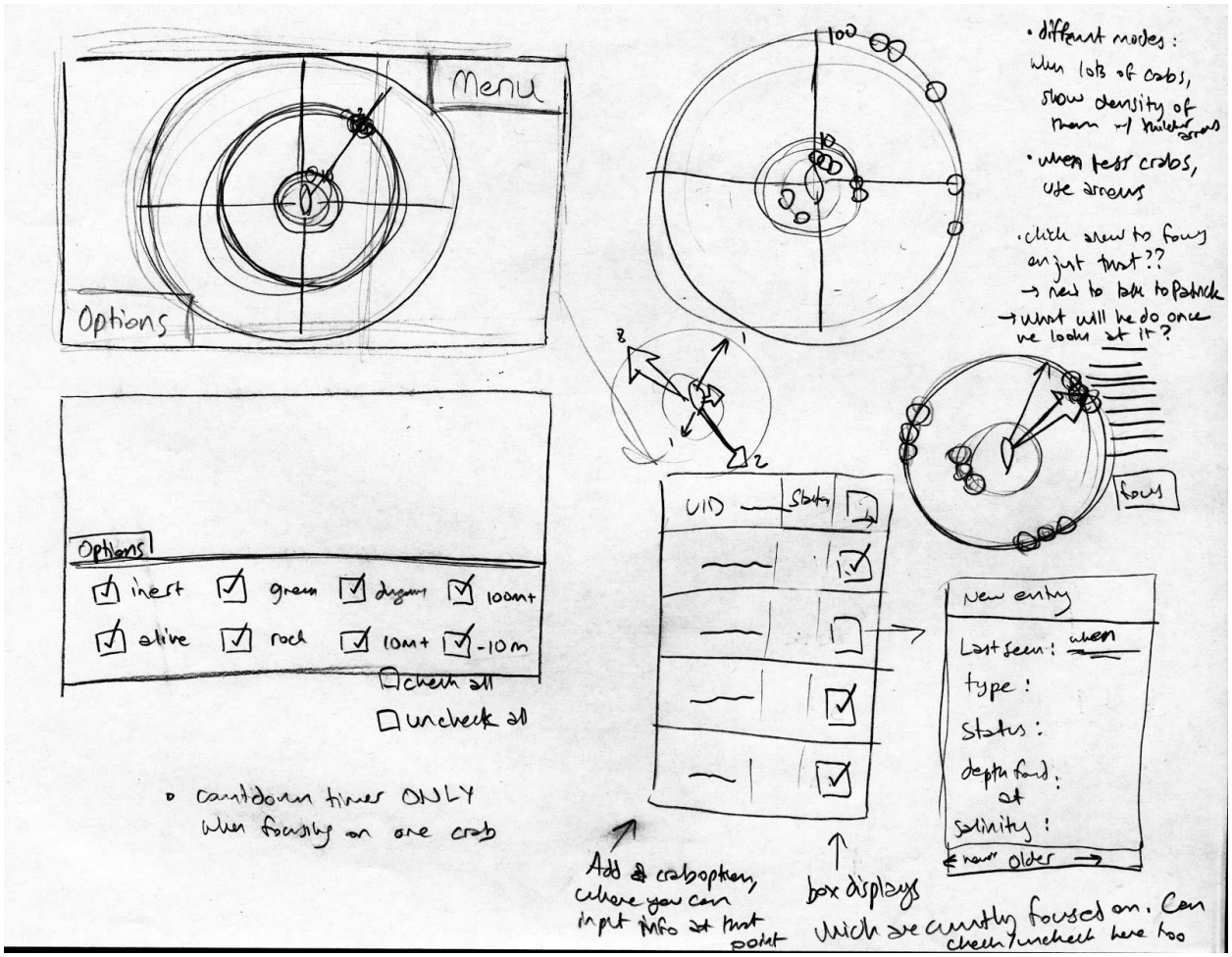


Figure 1. Original rough sketch for the first paper prototype showing the ideas we had for the main interface and settings panels to interact with the main display. The left two sketches show the development of the radar screen and some ideas for the options pane that display information.The right side shows more idea sketches for the radar theme and ideas for integrating the data entry workflow in to the UI.

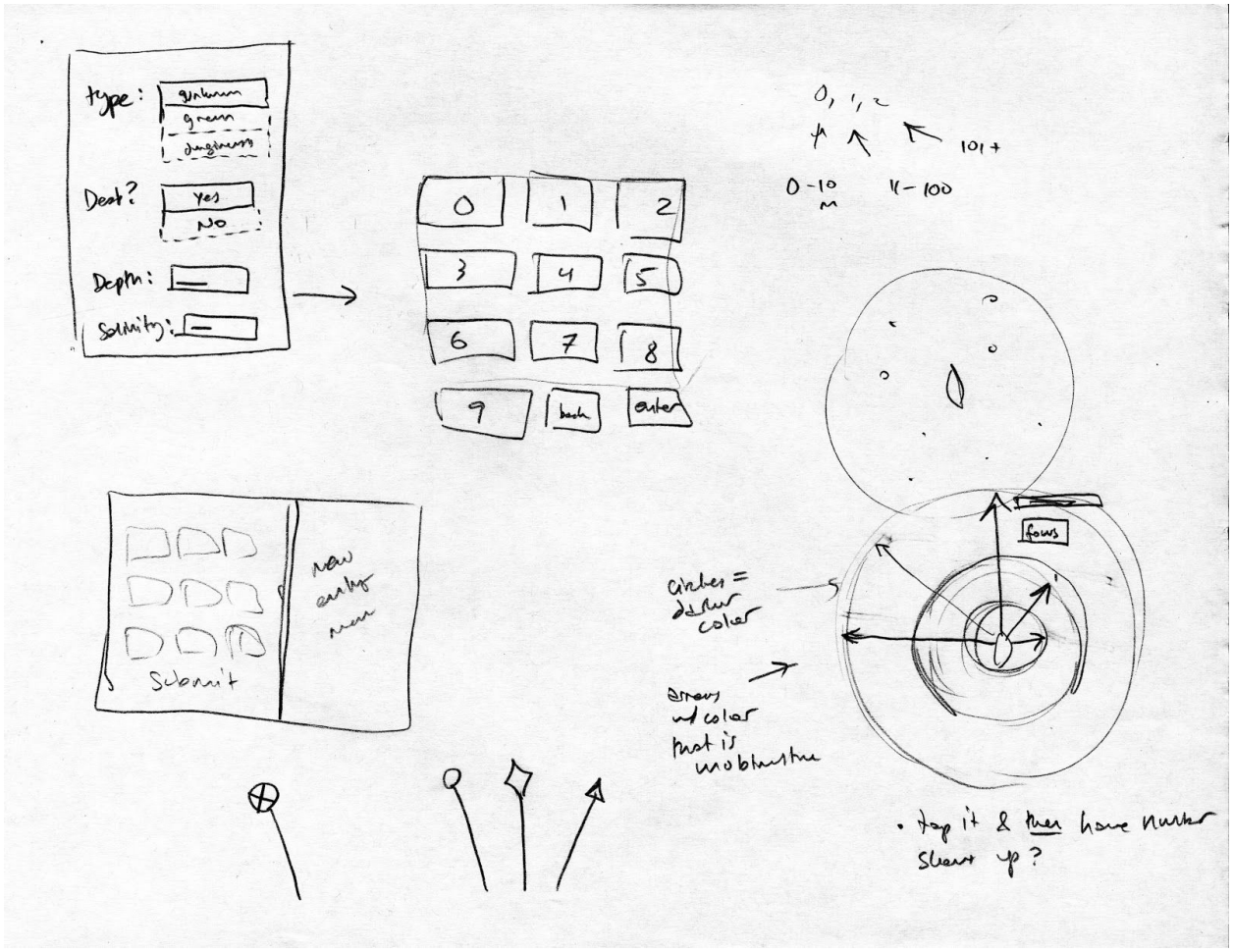


Figure 2. Early design ideas for different arrowhead types and number input screen for data entry workflow.

Original paper prototype

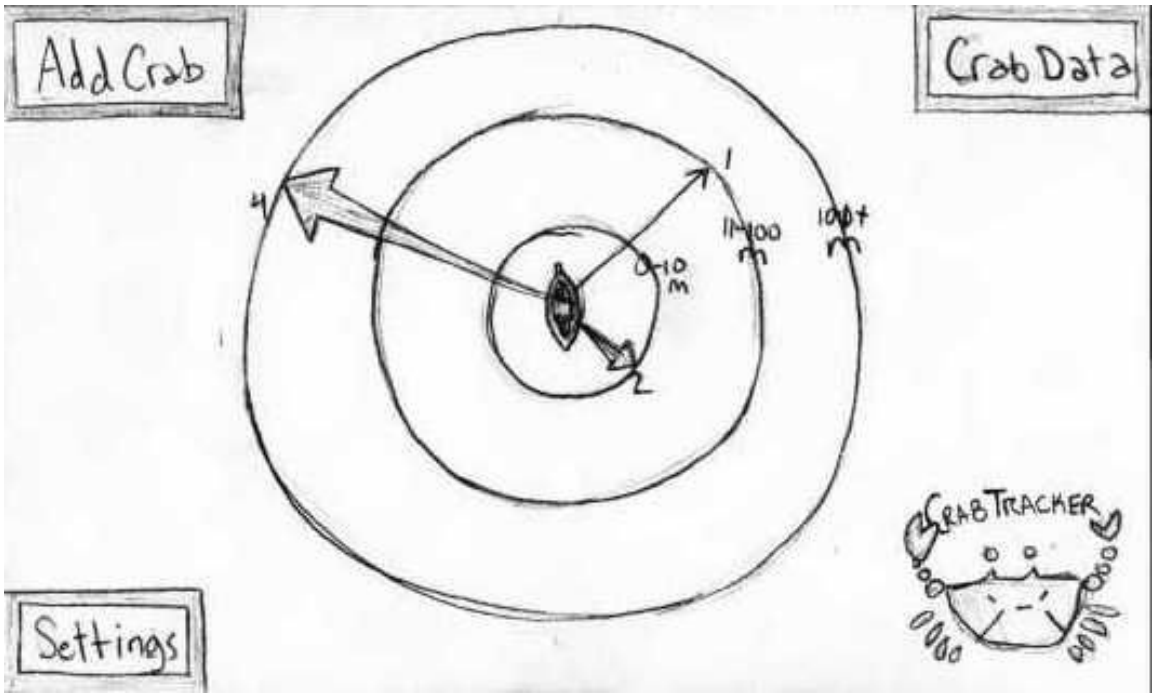


Figure 3. This is the main prototype screen, showing our original arrow-based directional system. The arrows point towards the crab's direction relative to the user's position. Bigger arrows show where there are groups of crabs close together.

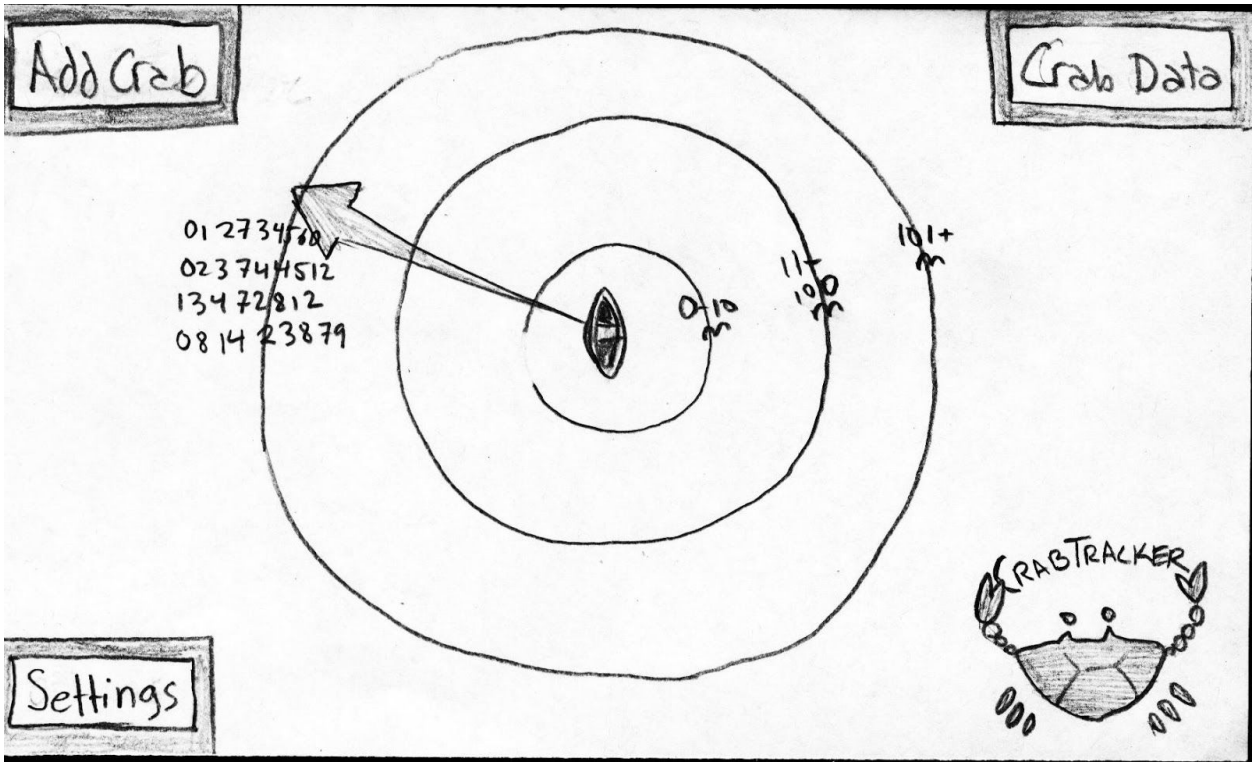


Figure 4. By clicking on a singular arrow on the previous screen, the user can focus only on that arrow, and the UIDs of the crabs at that location are shown.

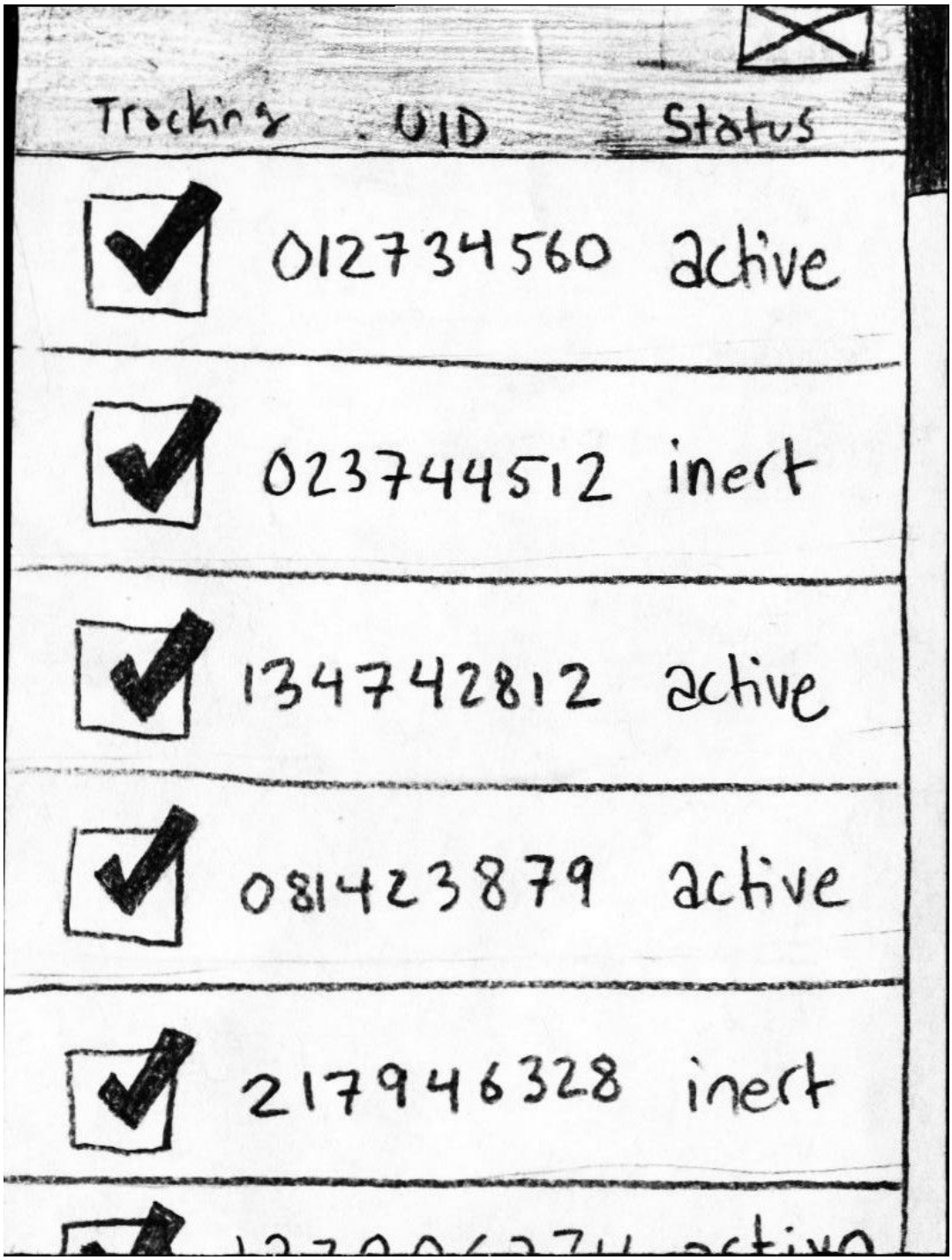


Figure 5. When the “Crab Data” button is selected this screen will appear, offering data on any crab the user may wish to see. The user can search for a specific crab, select to see all crabs, etc. This allows the user to closely monitor data for specific crabs and declutter the main screen for large amounts of crabs.

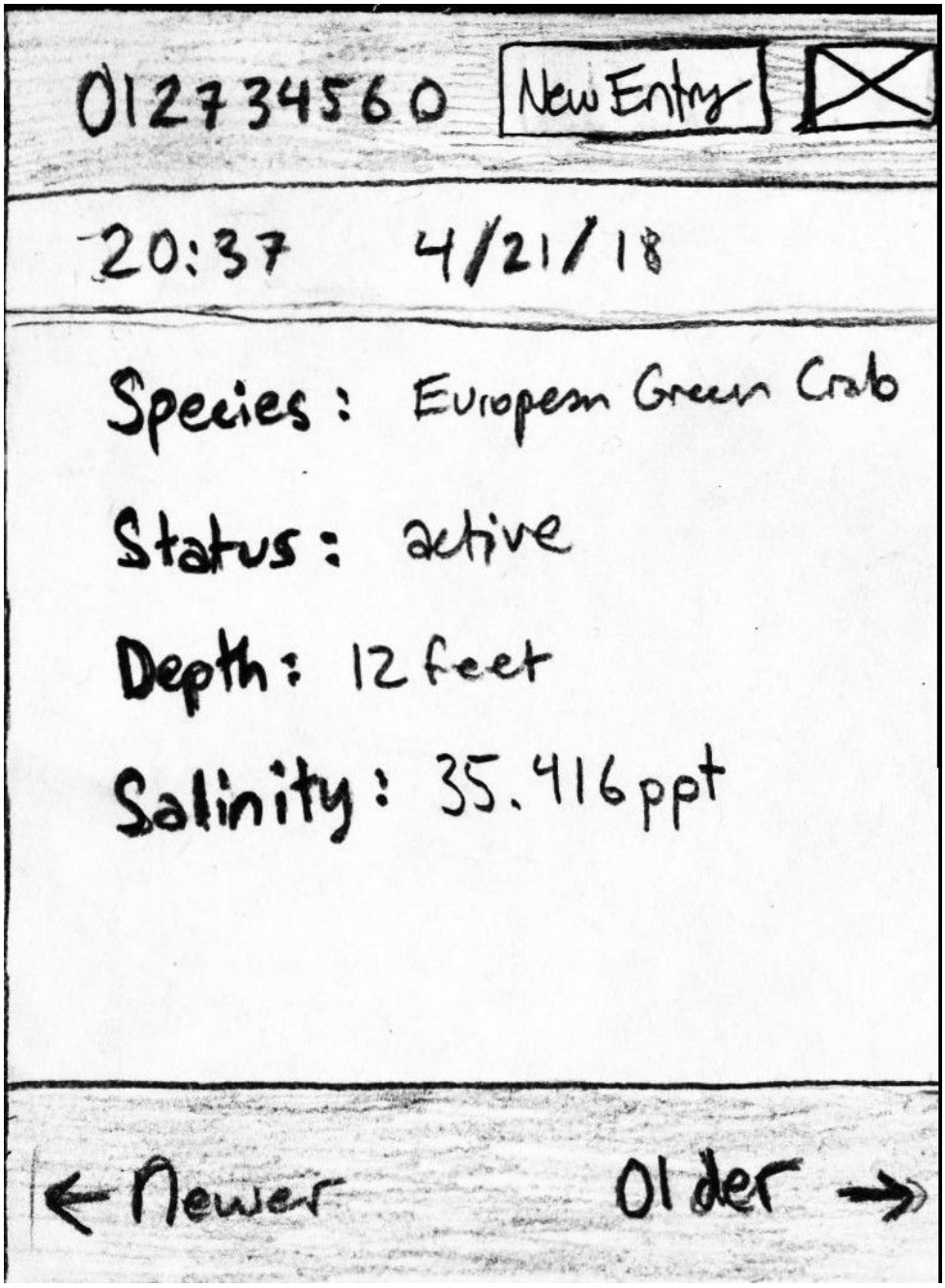


Figure 6. This screen allows users to peruse all information on the crab currently recorded, by selecting newer or older, or create a new entry. As you can see here, it was not possible to edit entries after saving them, and we were not sure what data the user would want to record.

Figure 7. This is the original screen to allow the user to add information on a crab. This screen will take up half of the screen and easily allow data entry. This page allows users to input environmental data collected at the site of a crab. This data is saved and stored for later look up so that the user can see how the environment surrounding the crab has changed over time. However, there is no need for this menu to only take up half of the screen, and that actually restricts the amount of info you can input.

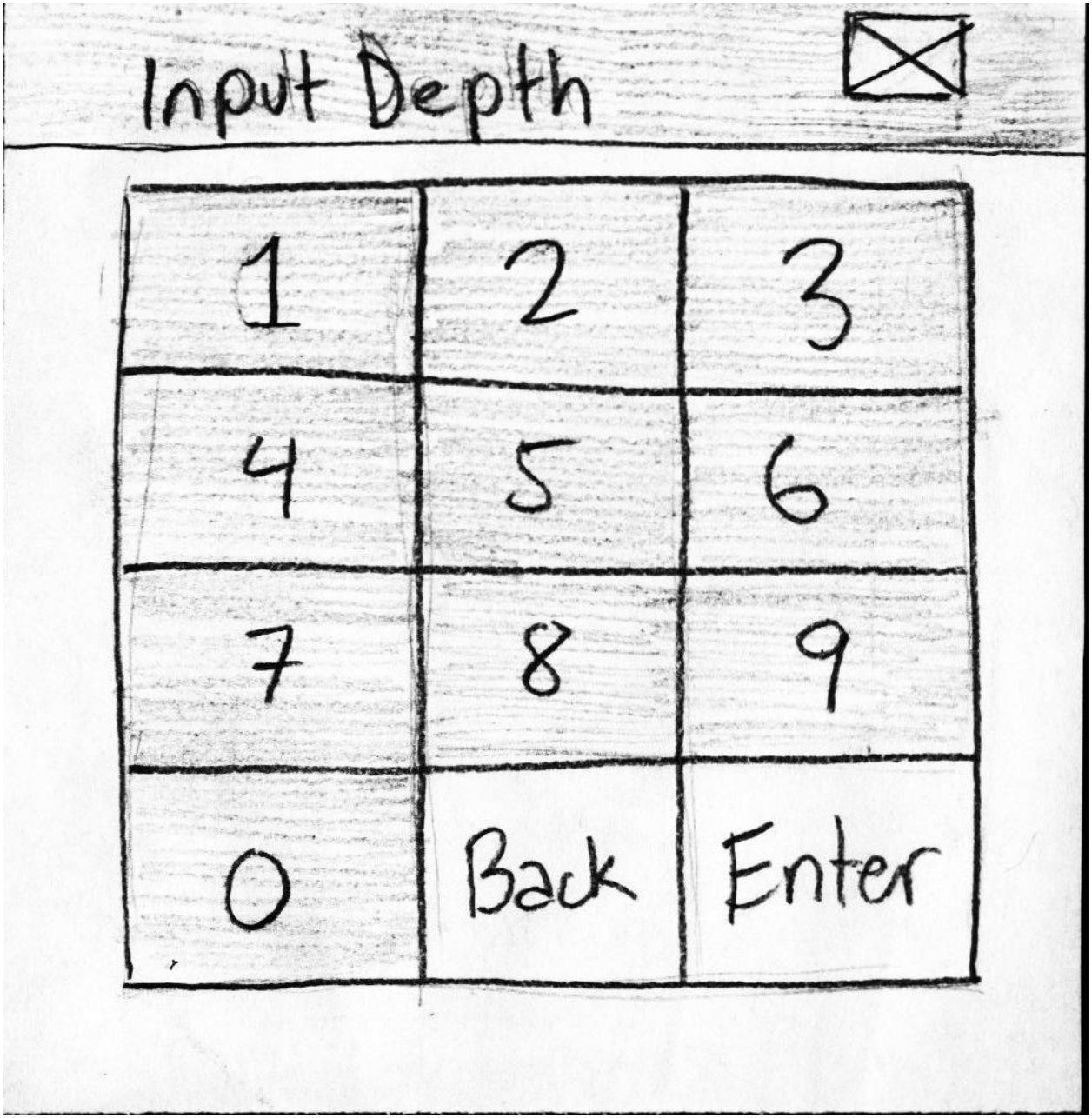


Figure 8. Our original number input screen follows the style of the previous images and only take up partial screen real estate to allow the user to enter information of numbers into the data entry screen. There is no way to see what you have typed, or any decimal place marker.

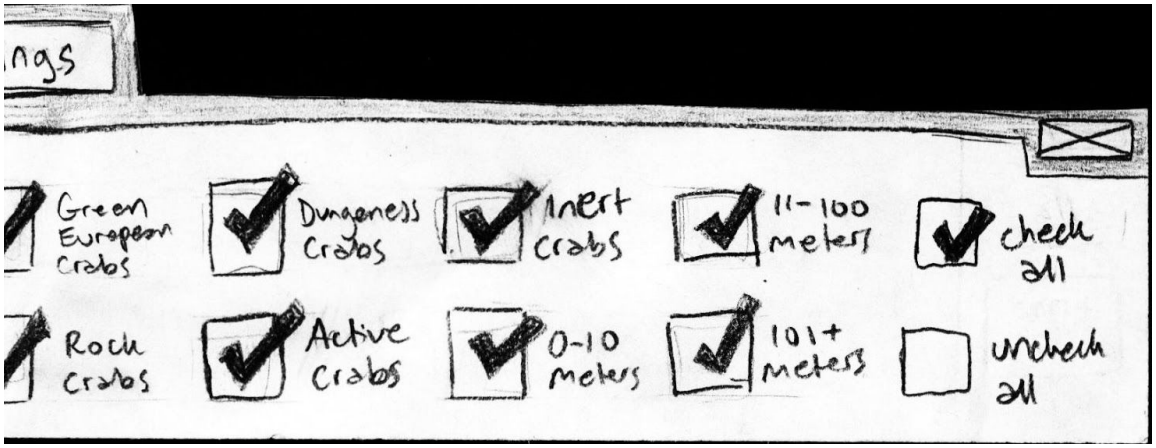


Figure 9. Our original settings menu allows the user to still see most of the main screen, so they can see how those changes affect the data shown. This screen actually does make sense as a half screen, but this format doesn't allow for many options, nor the space to organize them effectively.

Updated paper prototype

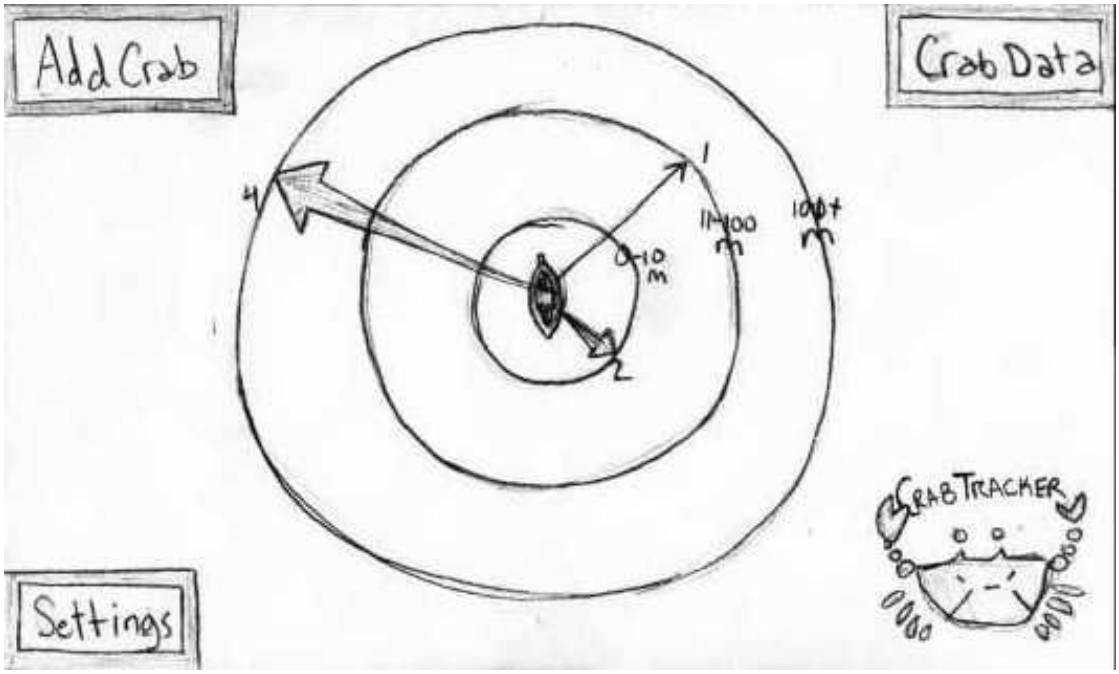


Figure 10. The same main screen is used in the updated prototype, as our main concern was changing all of the half screens to full screens.

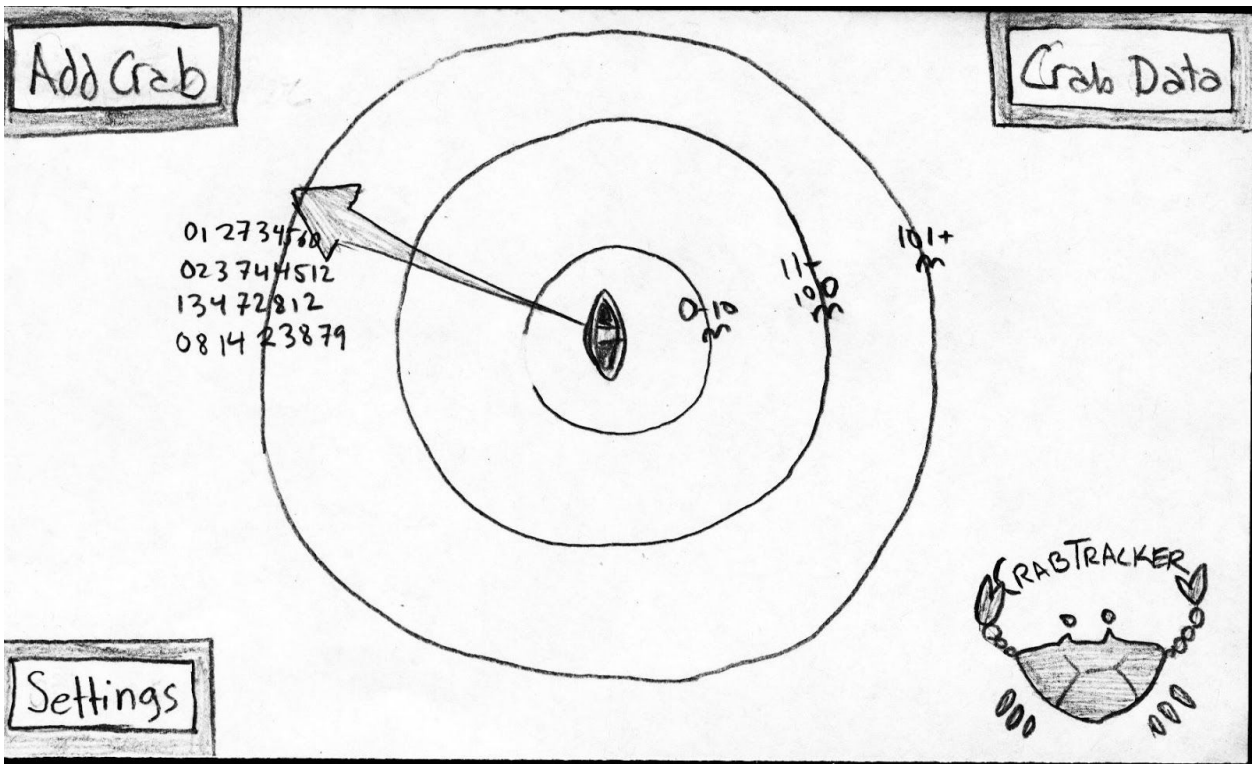


Figure 11. Again, the same prototype of the main screen is used in the updated prototype.

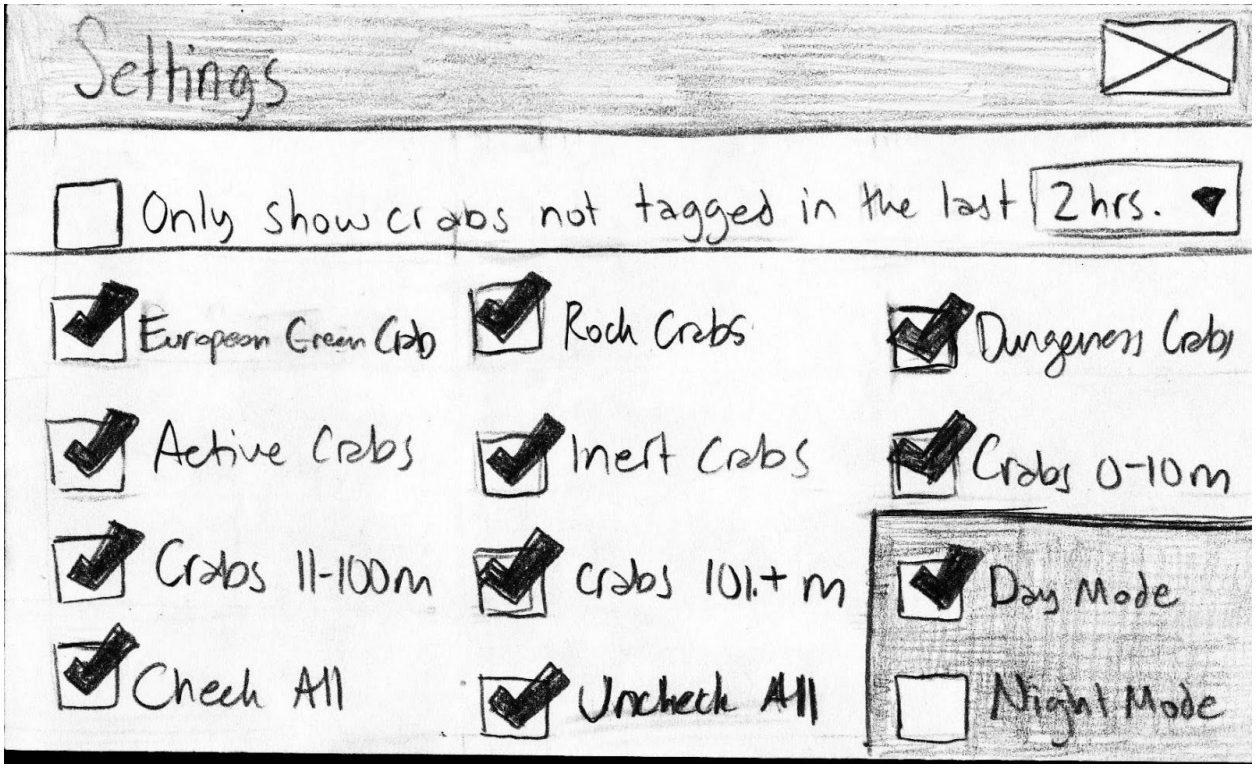


Figure 12. Updated, full screen settings panel. Selecting an option here will allow for the user to see that information about the crabs on the main crab tracking screen. Because we switched to using a full screen, it was possible to put a lot more options in this menu, and there was space to have some organization. That being said, it didn't make sense to have a settings menu that covered the main display.

Figure 13. This is the updated Crab Data screen. Because it is a full screen display, there was a lot more room to add options to sort through the crabs on this screen. As there will be up to 500 crabs in this system, it was important to add more sorting features. The downside to this screen is that it appears very cluttered.

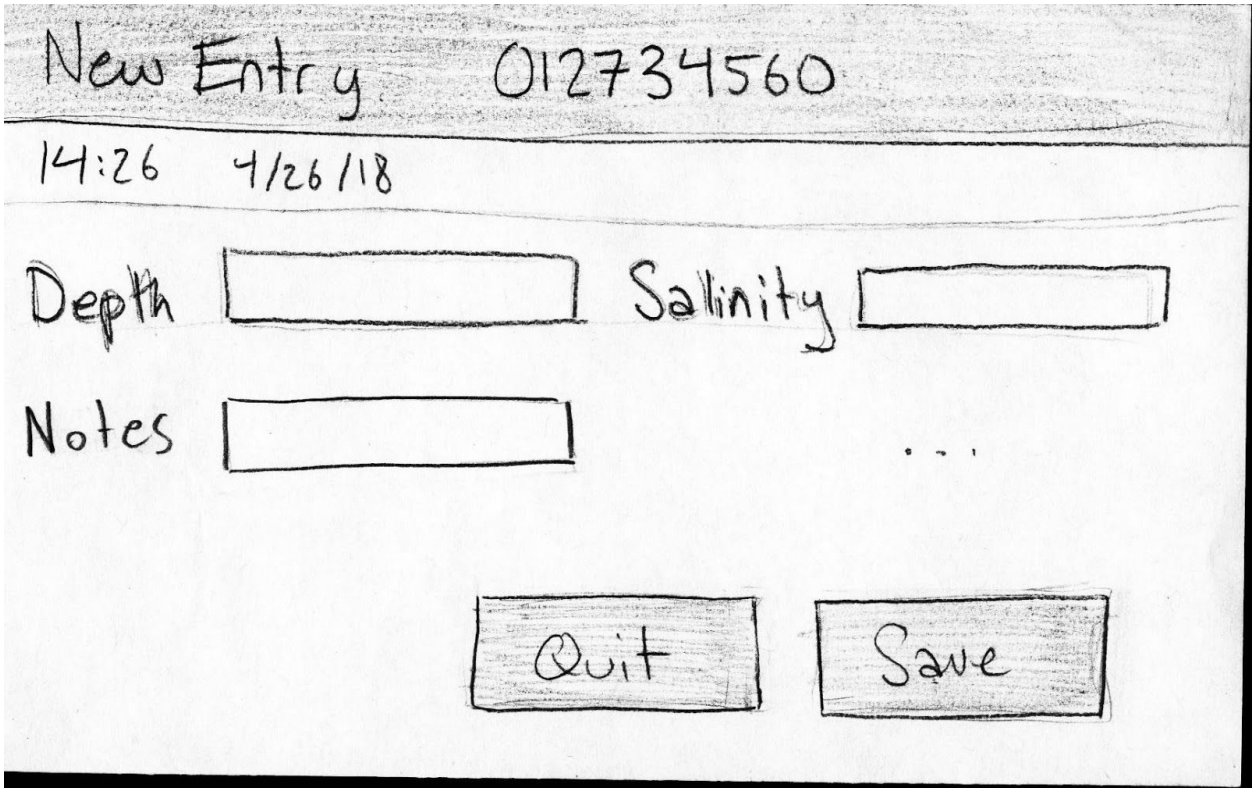


Figure 14. The updated new entry page. This has basically the same amount of functionality as the half screen display, as we still did not know the exact requirements.

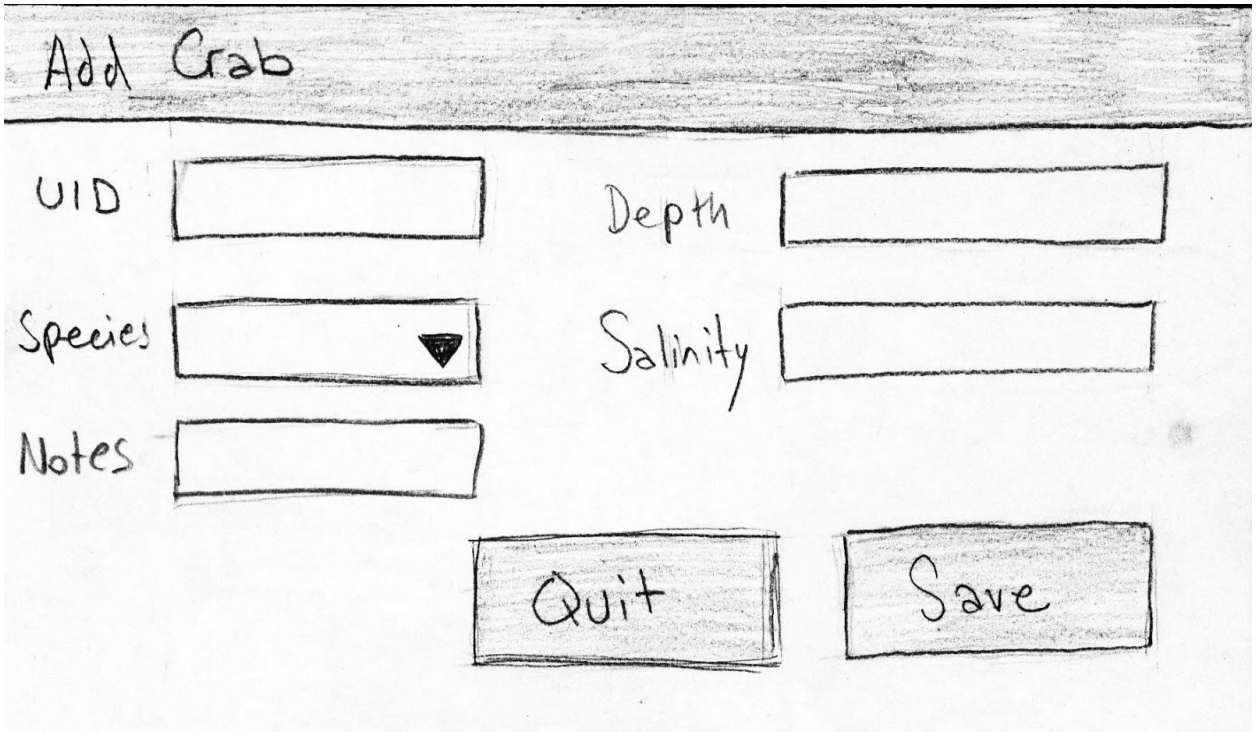


Figure 15. With the second paper prototype we added this feature, which we had overlooked in the first version. When adding a new crab from the main screen, this Add Crab screen appears allowing the user to input data for the specific crab being tagged, and allow for new crabs at any point in the research phase. Again, at this point we did not know specifically what the user would want to input.

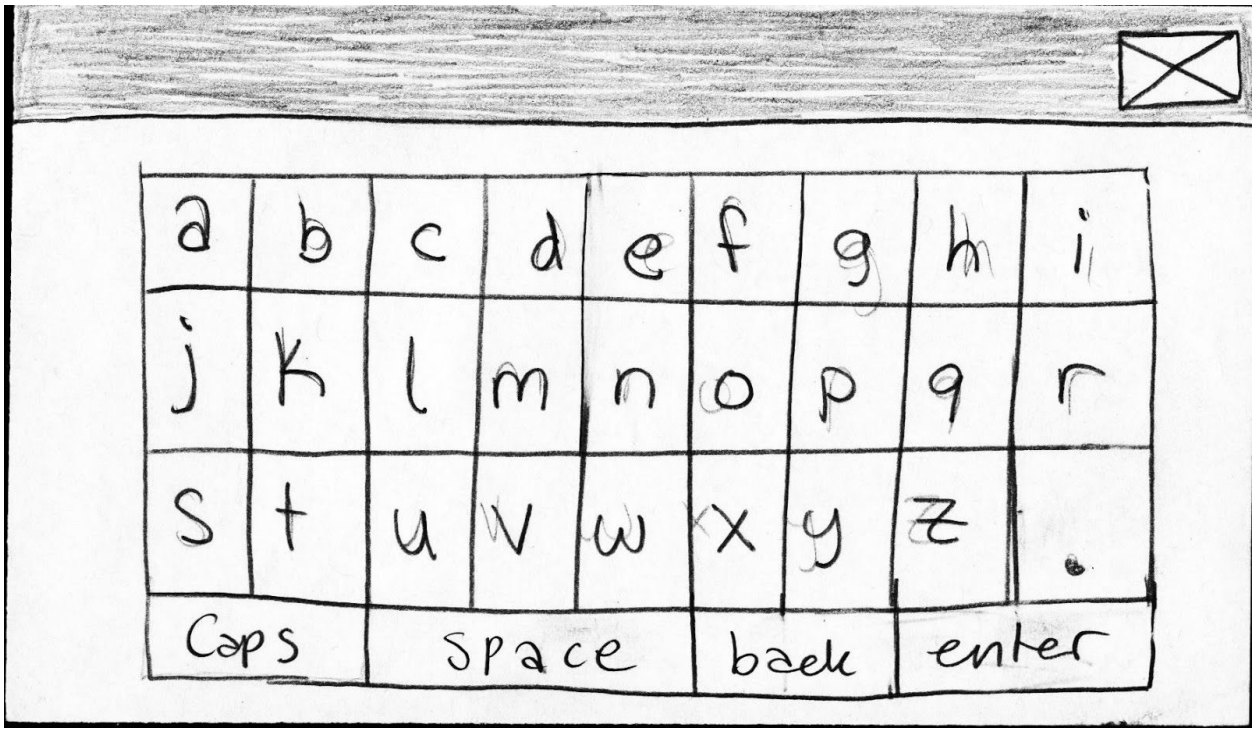


Figure 16. When manually entering data this screen appears to allow the user to enter text using the touch screen. This is made separate from any OS keyboard, so that the user can have an easy time typing on the screen.

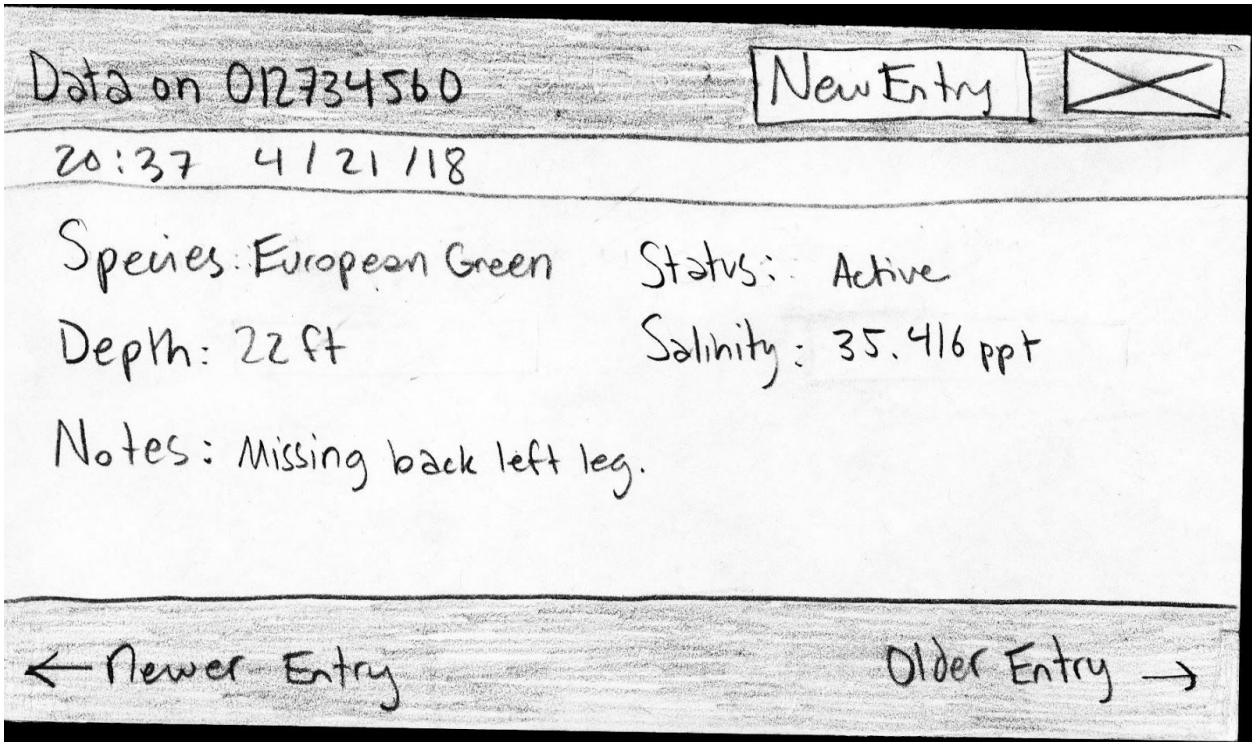


Figure 17. After adding a new data entry to the crab tracker the user will see this screen, displaying the information just added about the crab and its environment. As this is a full screen display, you can display more information, and have it not be as cluttered.

Final Prototype:

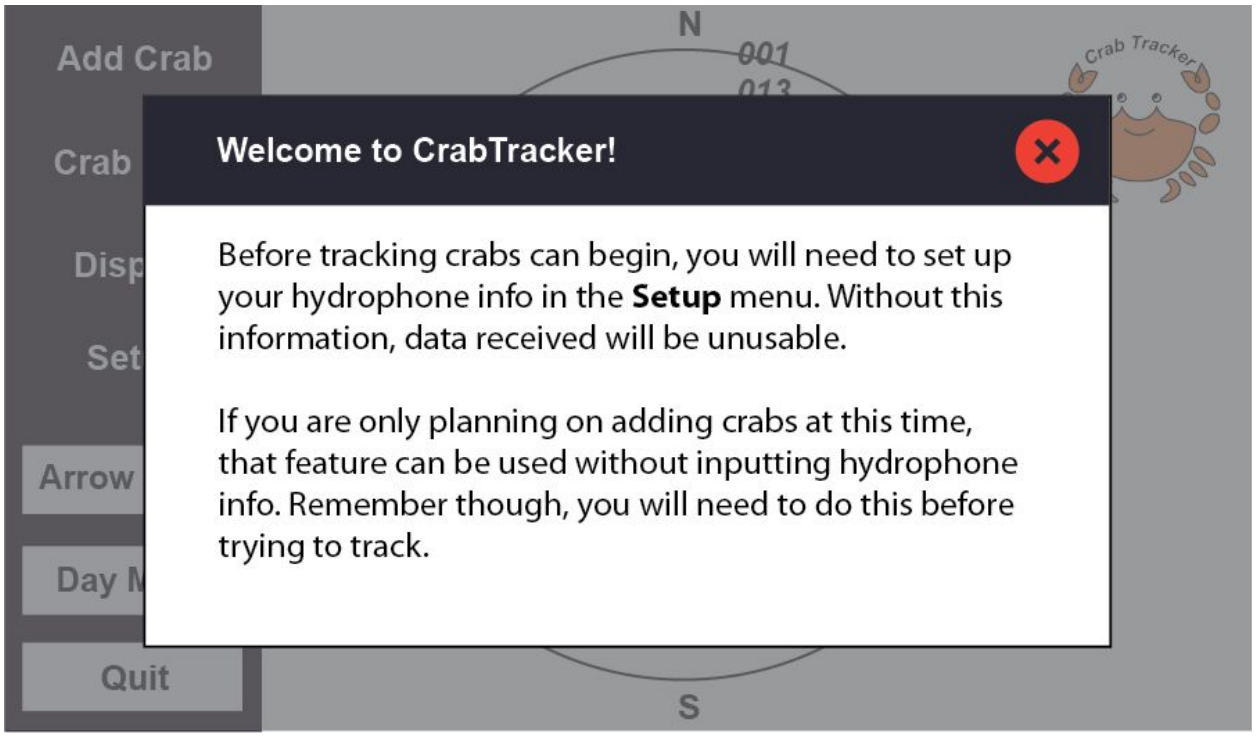


Figure 18. This popup is a new feature that will only show up once, when you first open the program. It serves as a reminder to input the hydrophone information, which is necessary for the raspberry pi to correctly understand the radio waves sent, to locate the crab's distance and position.

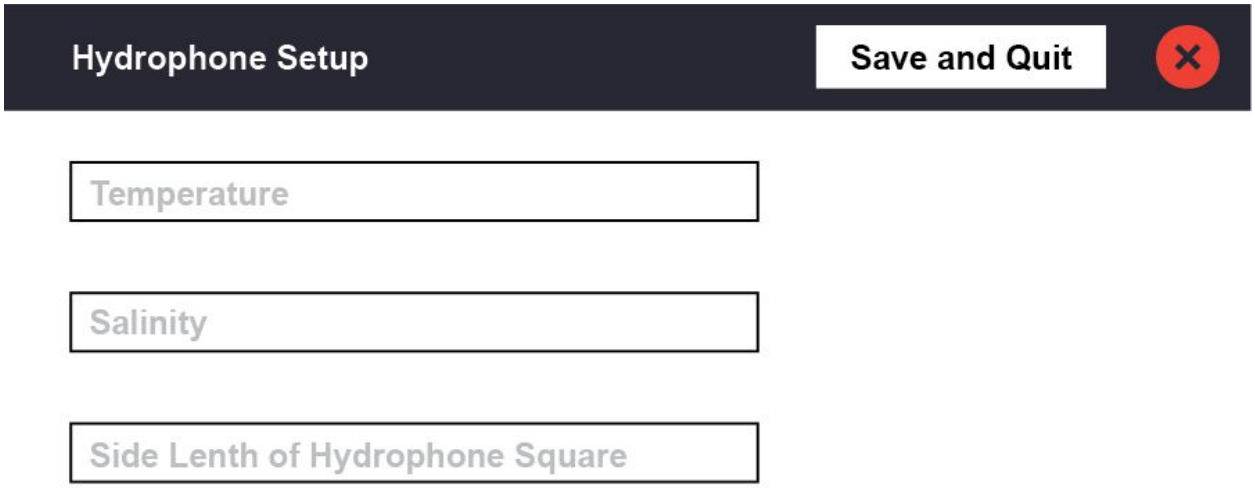


Figure 19. This is the screen to input information on the hydrophones. As these three data points are the only important ones, this screen is relatively minimal. Each of the input sections require the user to type in the information.

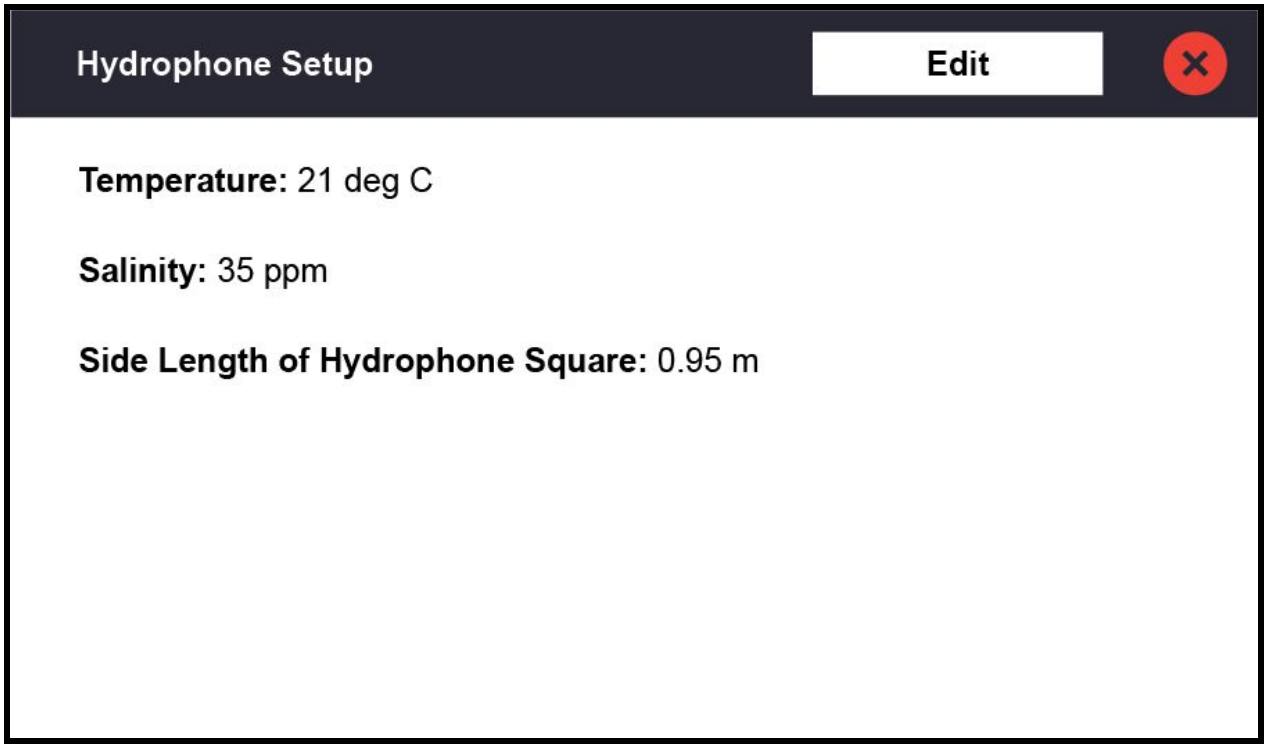


Figure 20. This is what the hydrophone screen looks like when there is information inputted. It can be edited by the user whenever necessary.

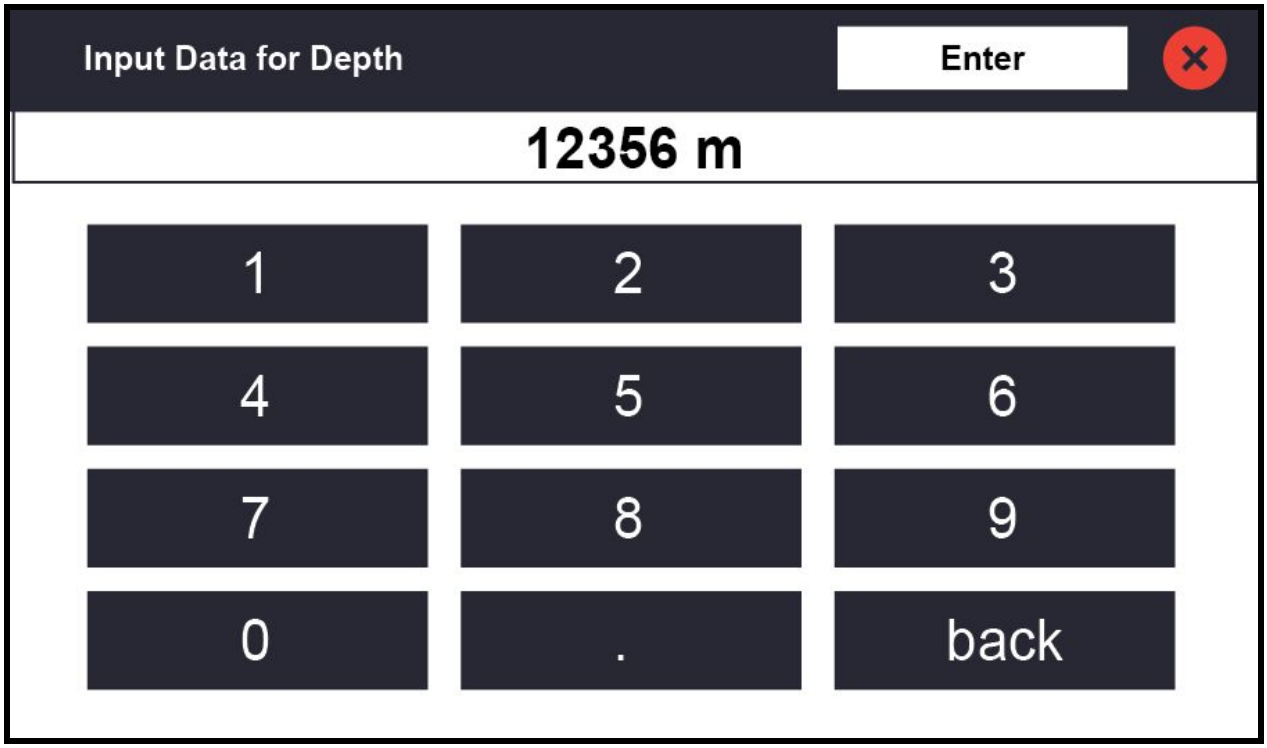


Figure 21. This is the updated number inputting screen. It has a section at the top to display what you have typed, and what unit you should be recording in (here it is meters). There is also a decimal place button now, and a cleaner aesthetic with buttons that are separated enough to avoid errors.

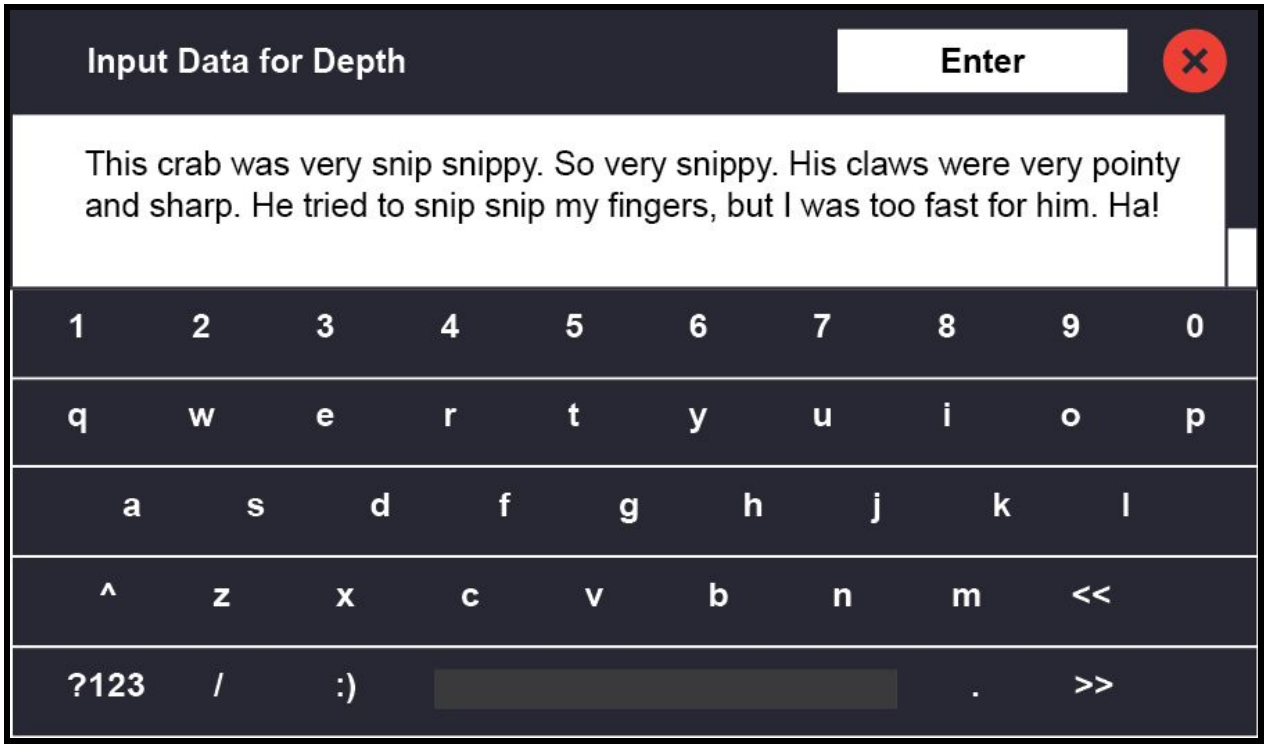


Figure 23. This is the updated keyboard screen, based off of a phone keyboard, when the phone is turned sideways. The black on white theme makes it easier to see, and there are far more buttons for the user to use. Additionally, there is a section at the top that shows what you have typed, which should naturally scroll down as you type.

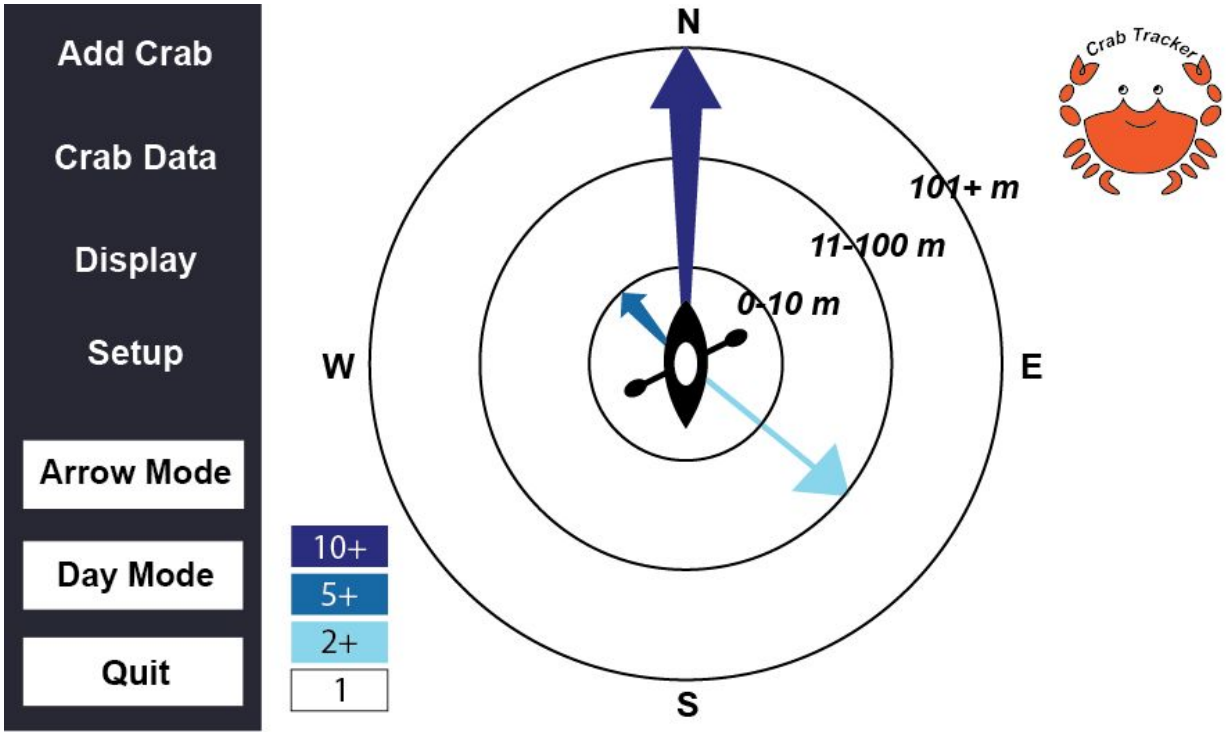


Figure 24. This is the updated arrow display screen. All of the buttons have been moved to the left, which makes more sense when compared to other common screen displays. They are displayed with the most commonly used buttons at the top. The arrow display itself now combines color indicators and the size of the arrows to get the point across more accurately. Additionally, the edited logo is smaller and in the top right corner instead of the bottom right.

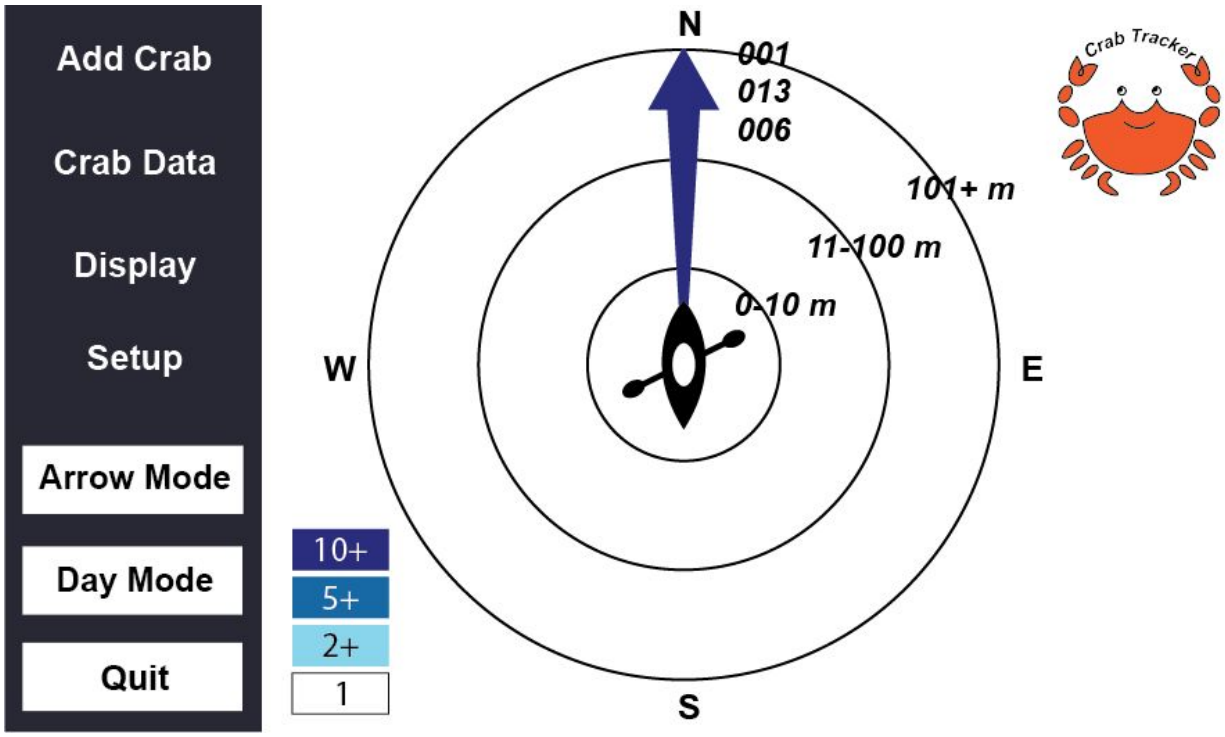


Figure 25. This is what the new screen looks like when only one arrow is selected.

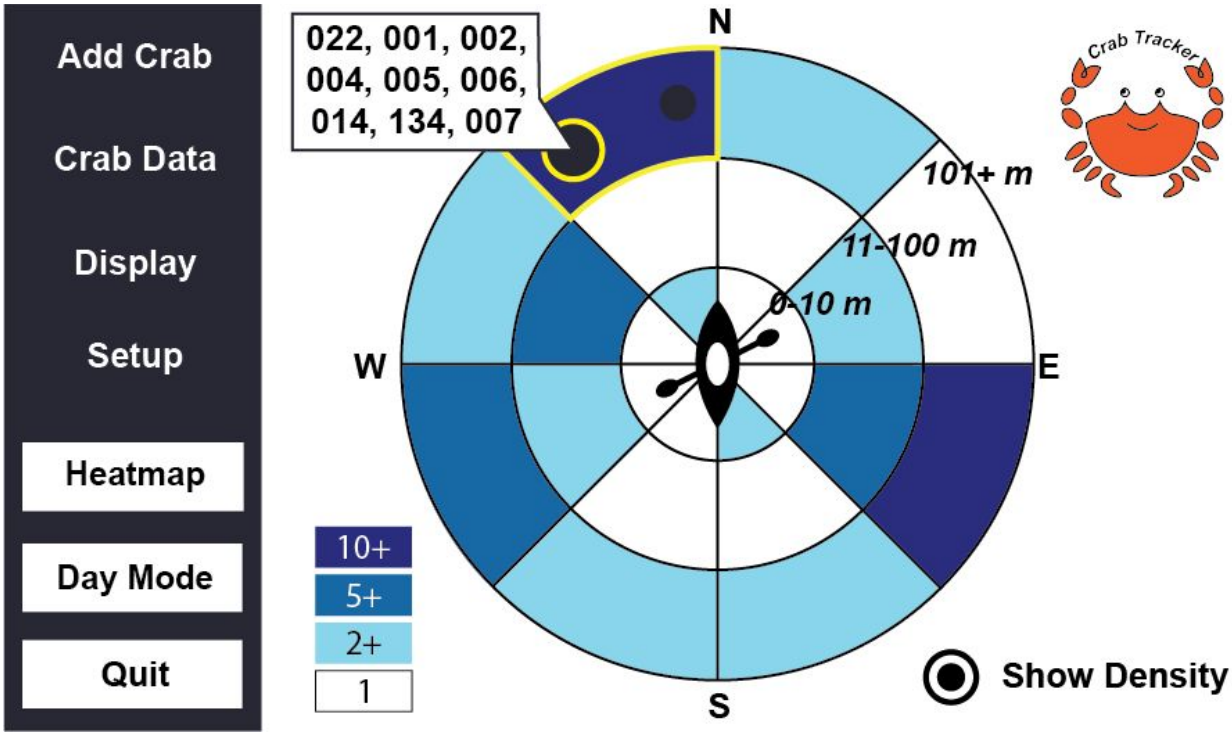
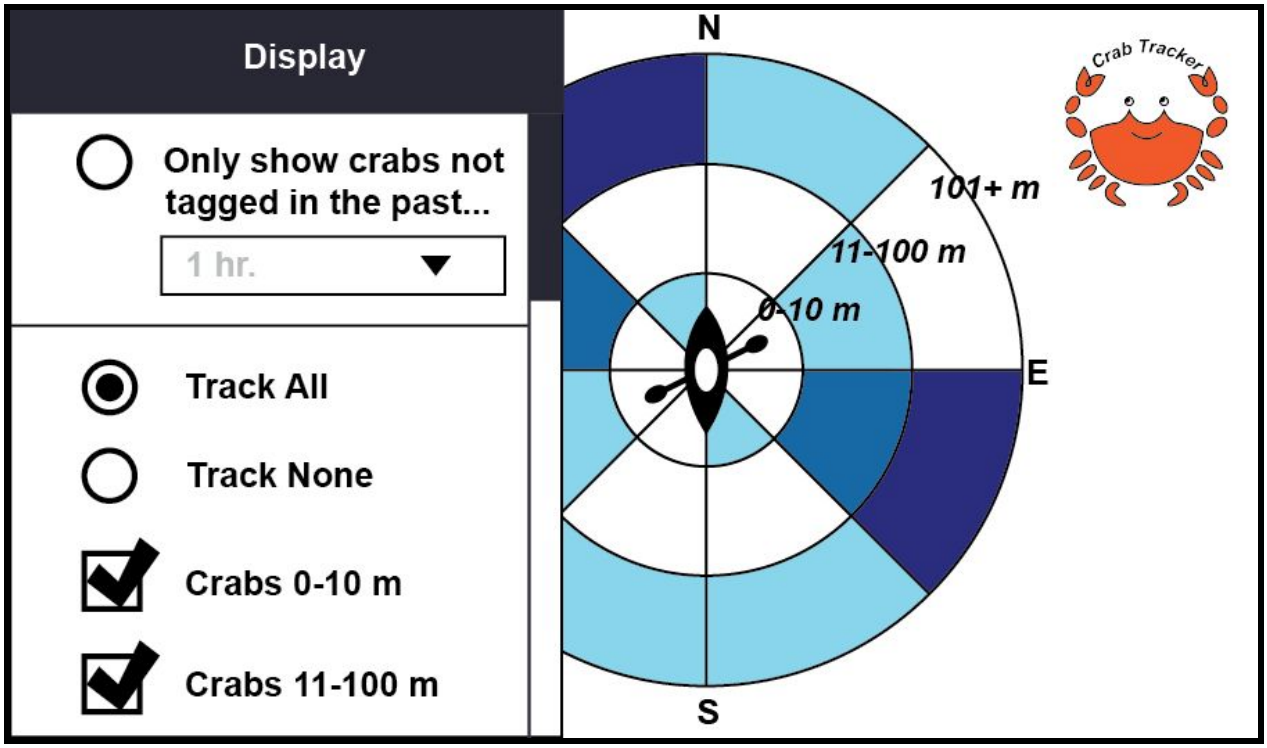


Figure 26. This is the new 'heatmap' display, with color coded sections displaying roughly how many crabs are in each area.



Figures 27, 28. This is the updated display window, which used to be called settings. Display made more sense as a name, and now it is only a half screen display, but also shows a lot of options because of the scroll bar.

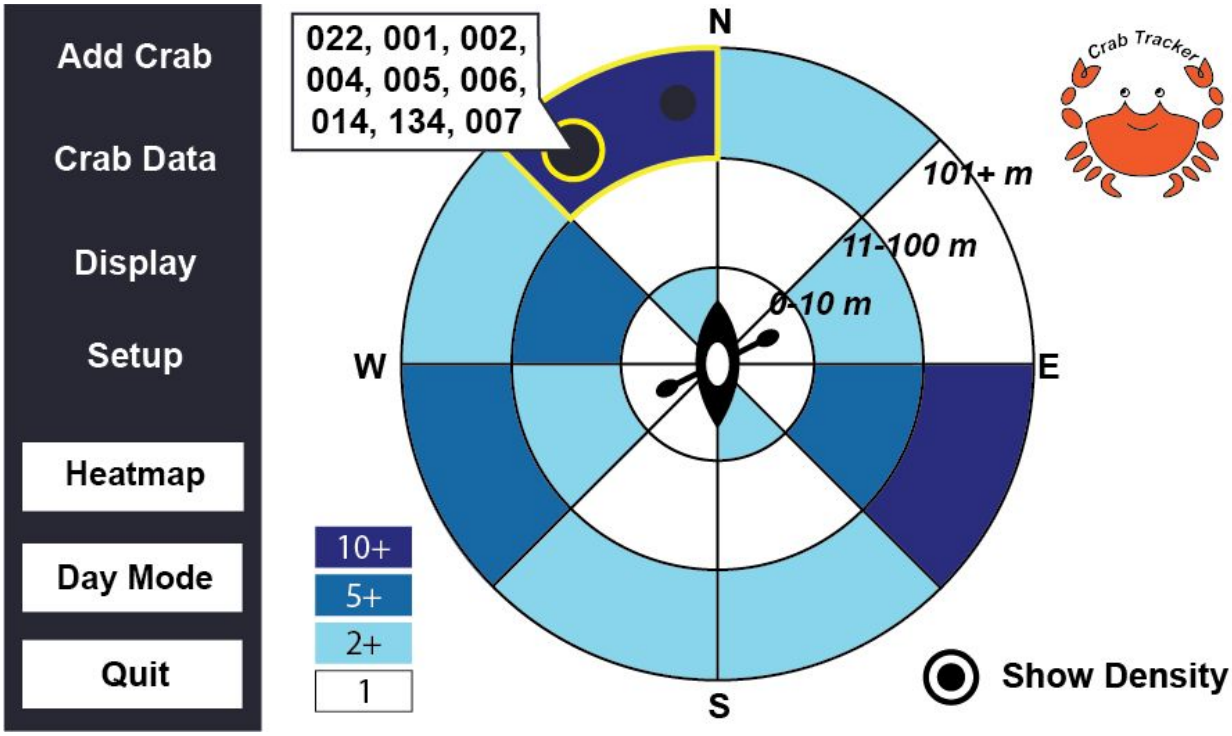


Figure 29. With the heatmap display, you can select one part of the radar screen to focus on, and it will display dots of different sizes that represent different amounts of crabs at that location. If you press on a single dot, all of the UIDs of the crabs at that location will be displayed.

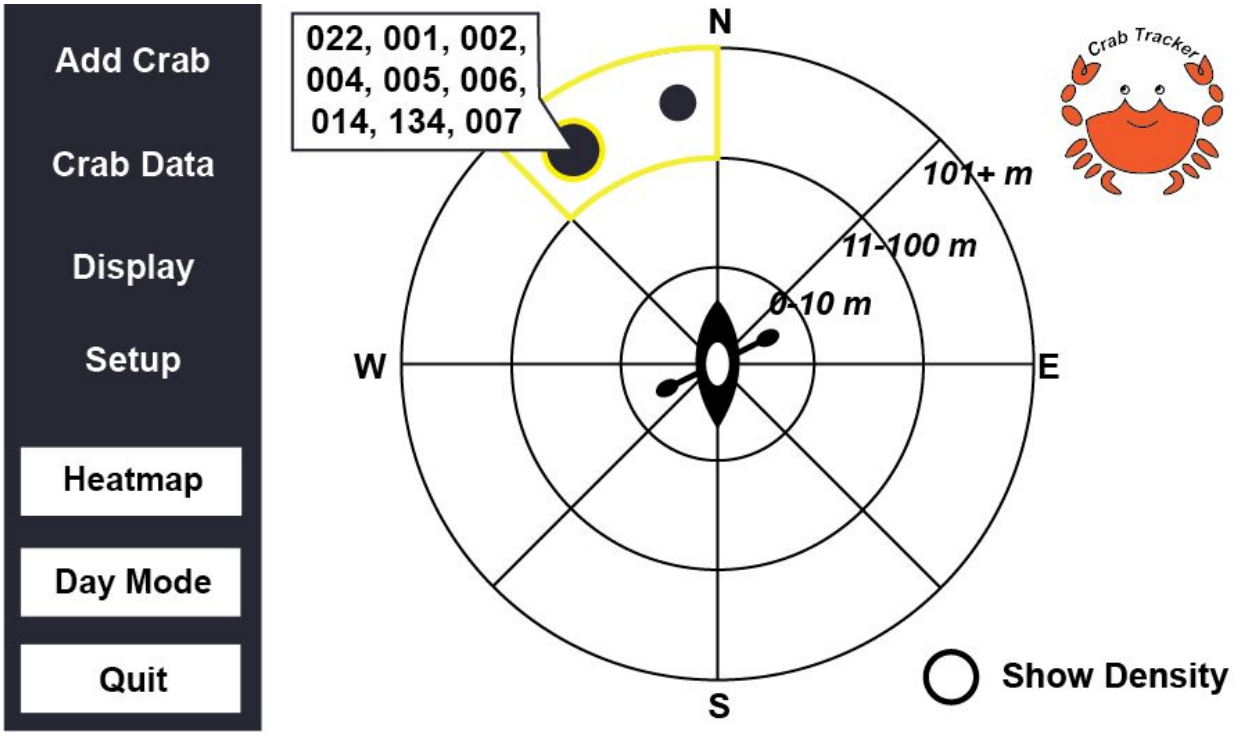


Figure 30. This is the same display as the previous, but shows how you can turn off the density display in order to focus just on specific crabs, without being distracted by the moving backgrounds.

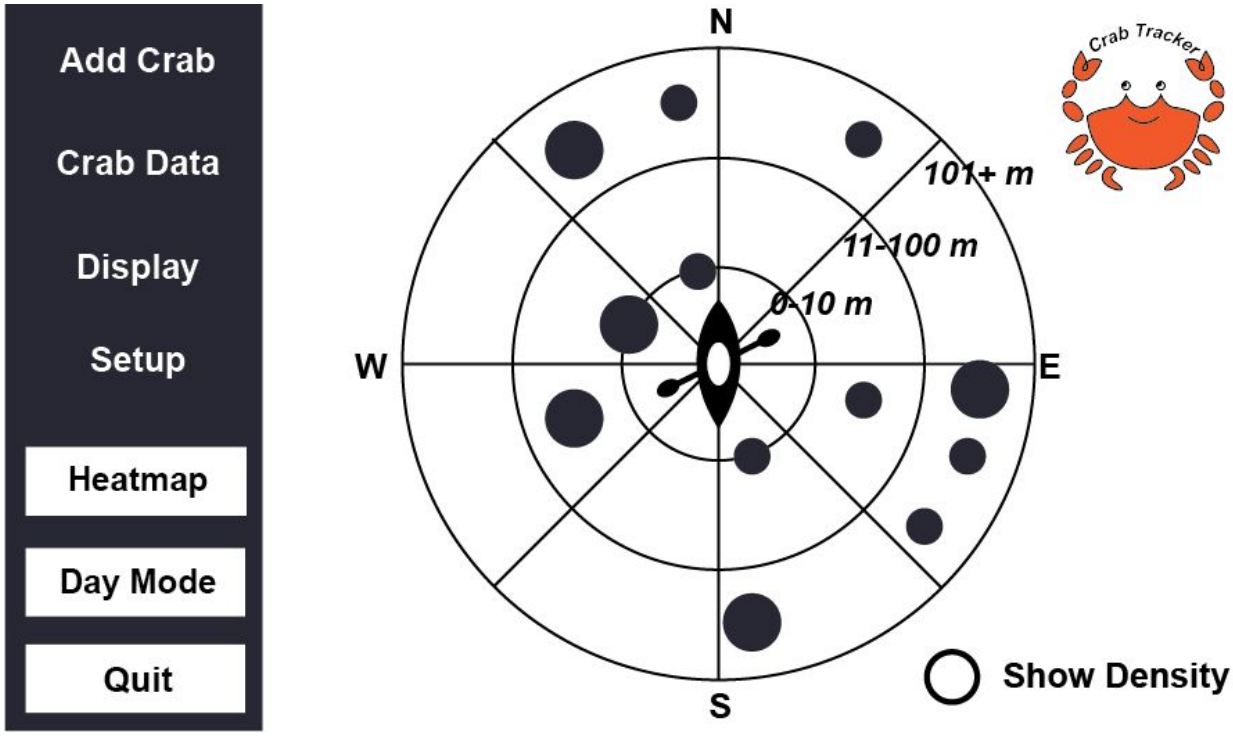


Figure 31. This is what the screen would look like if you did not have the density map on, and were tracking a specific group of crabs.

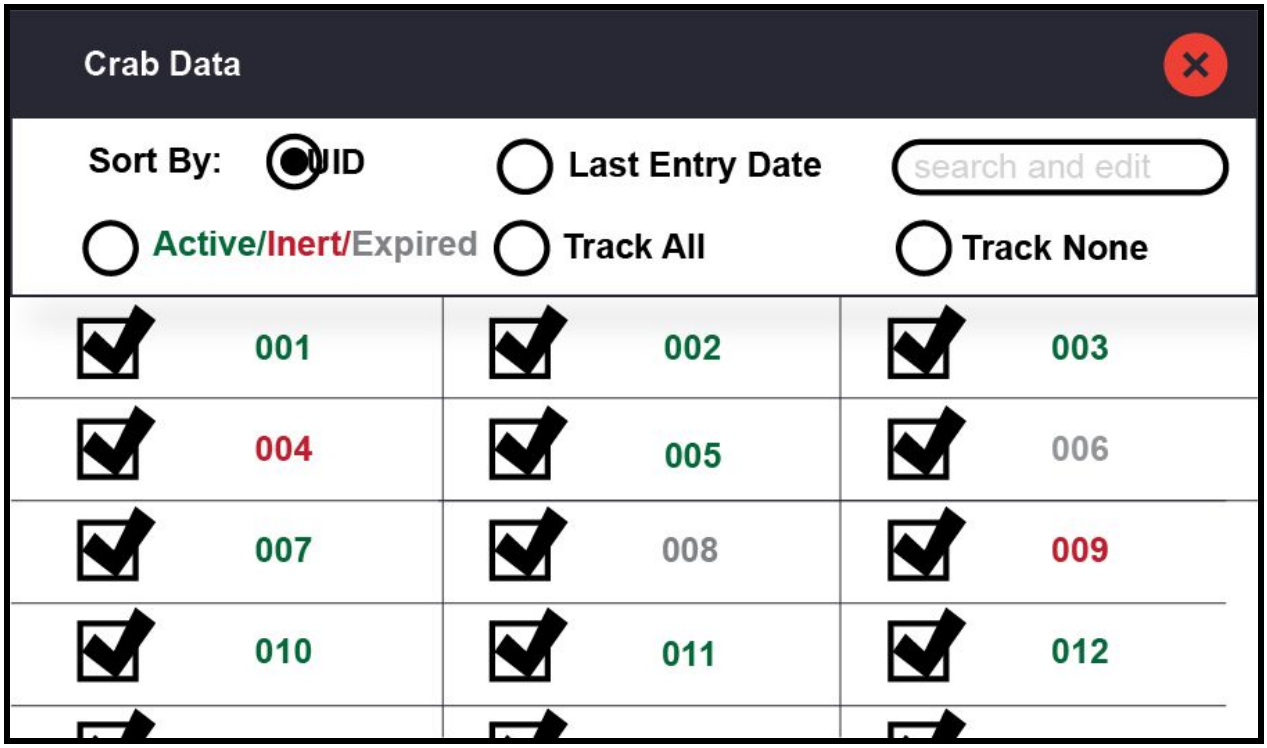


Figure 32. This is the updated crab data screen: it is full screen to allow for more data and options to be presented, but combines the use of color with the written information to display status is a cleaner manner. As a result, the screen no longer looks cluttered.

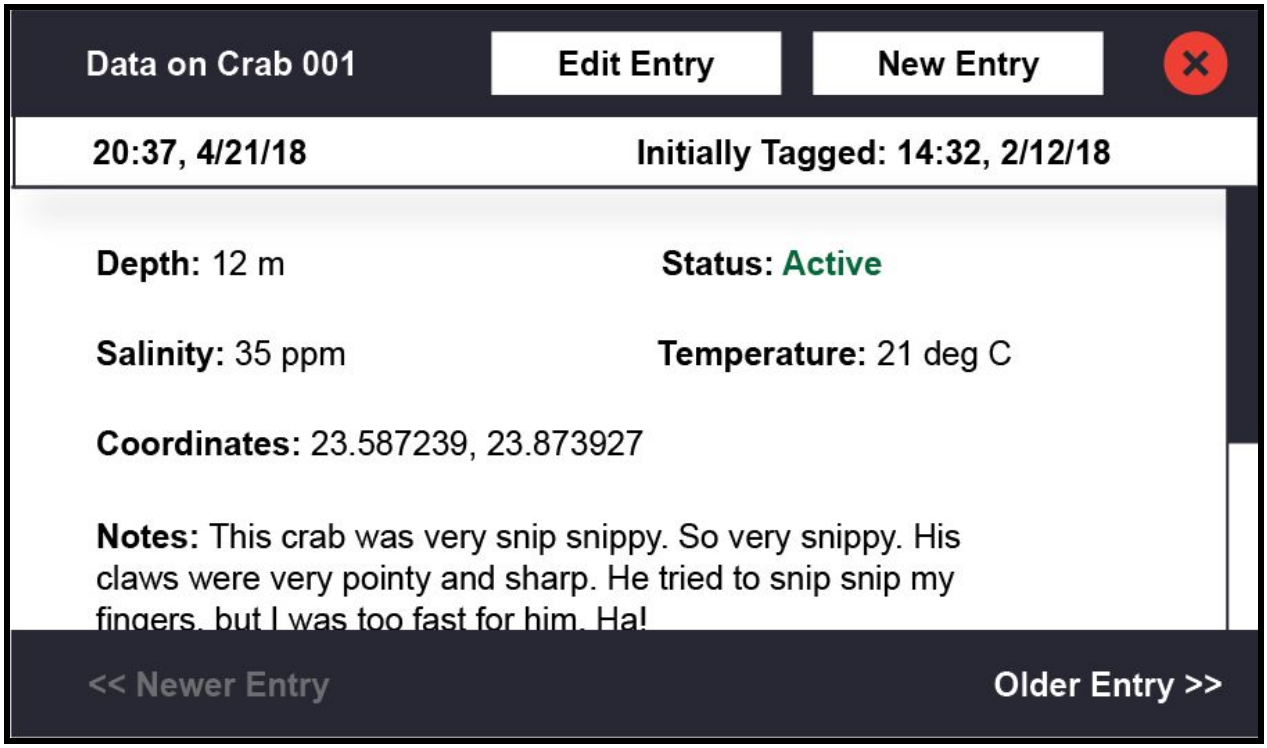


Figure 33. This is the updated Data Entries page: it allows you to edit old entries, has the date the crab was initially tagged listed, and has the accurate information our user base wants to record.

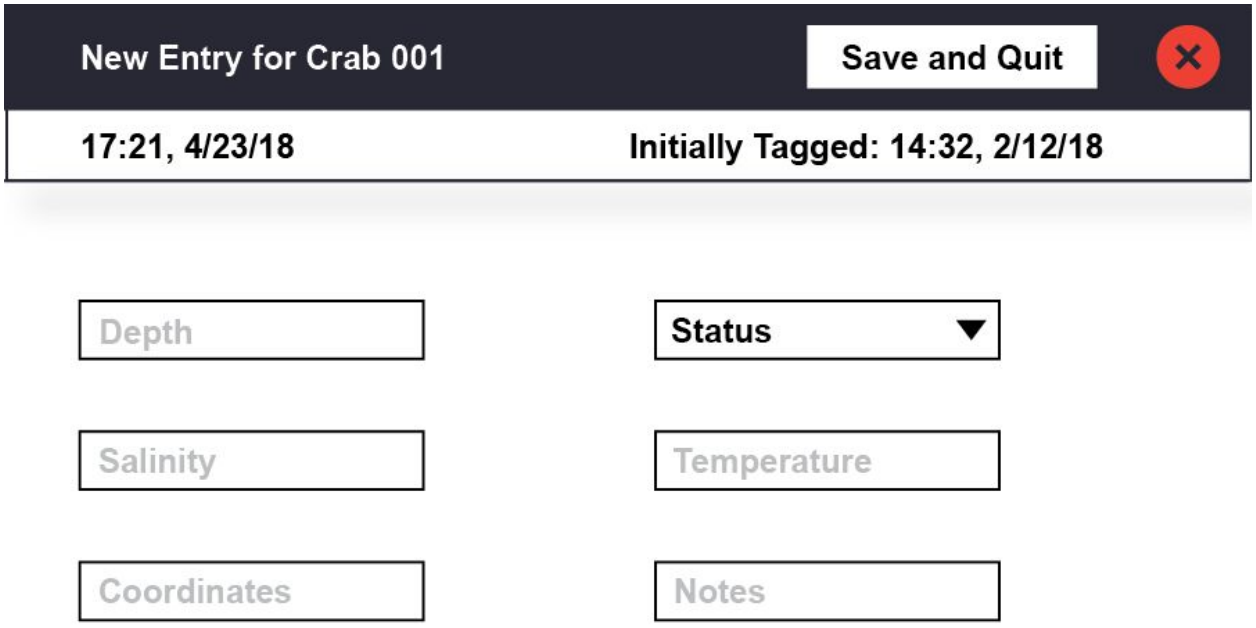


Figure 34. This is what the screen looks like now to record a new entry, with the correct data being recorded.

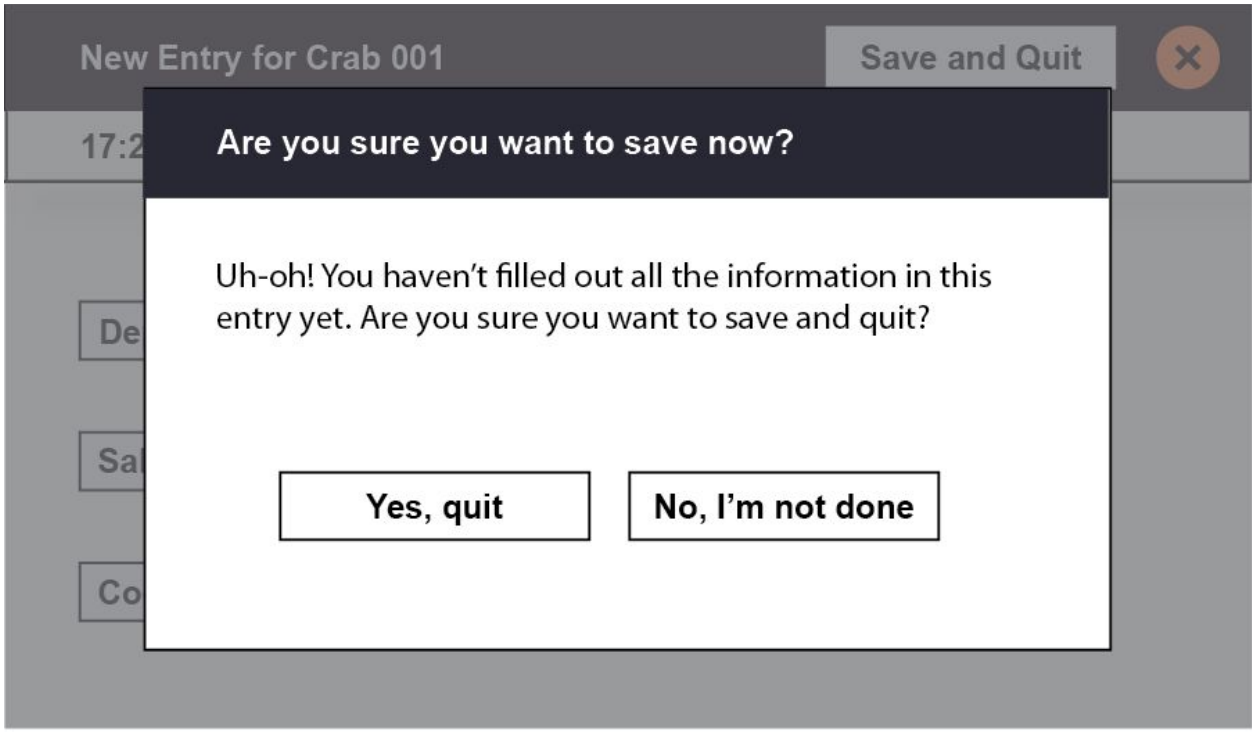


FIgure 35. If you attempt to save and quit without having inputted all of the information, this popup will stop you, as was requested by our user base.

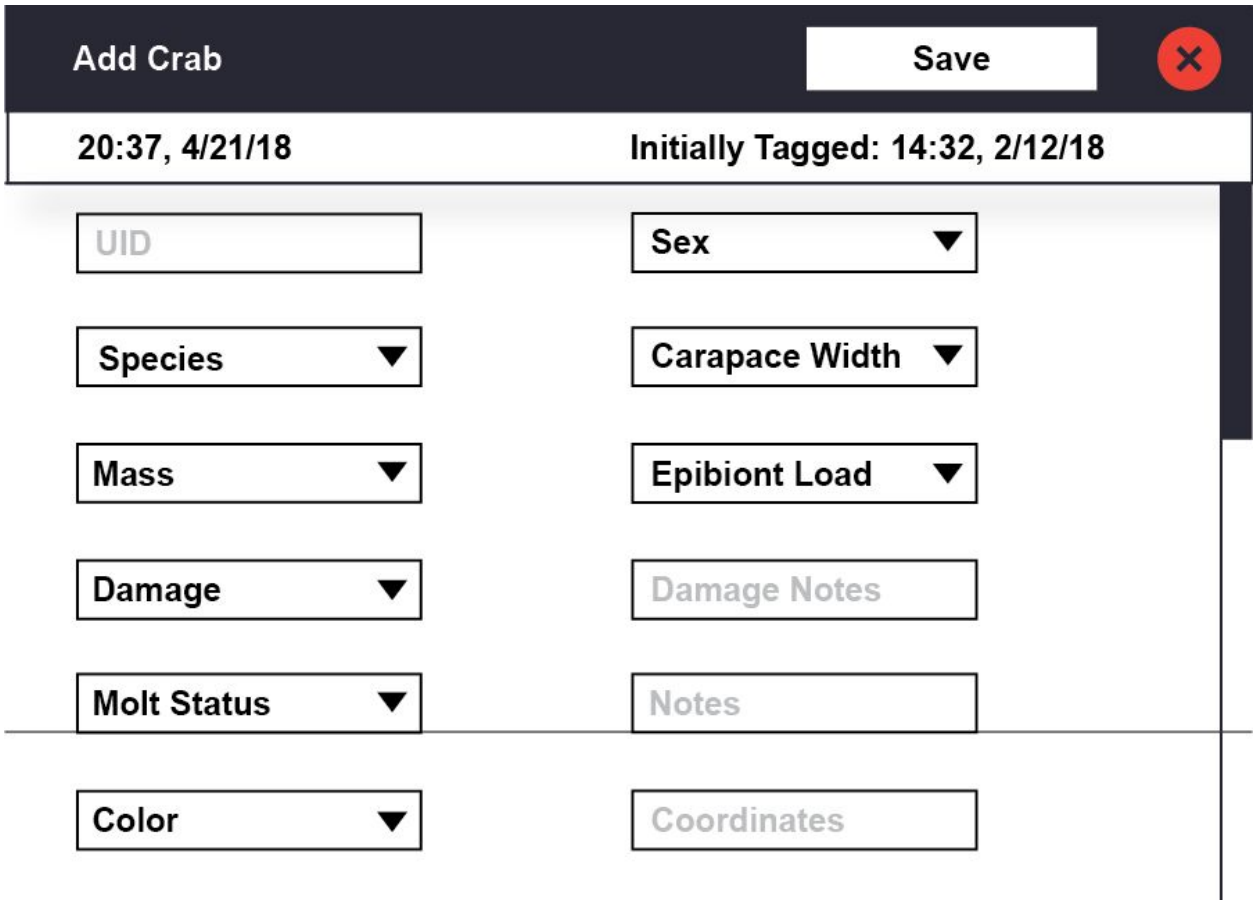


Figure 36. The new section to add a crab has more options than before. Some things here, like color, are only applicable if a specific species is selected, and are otherwise not available.

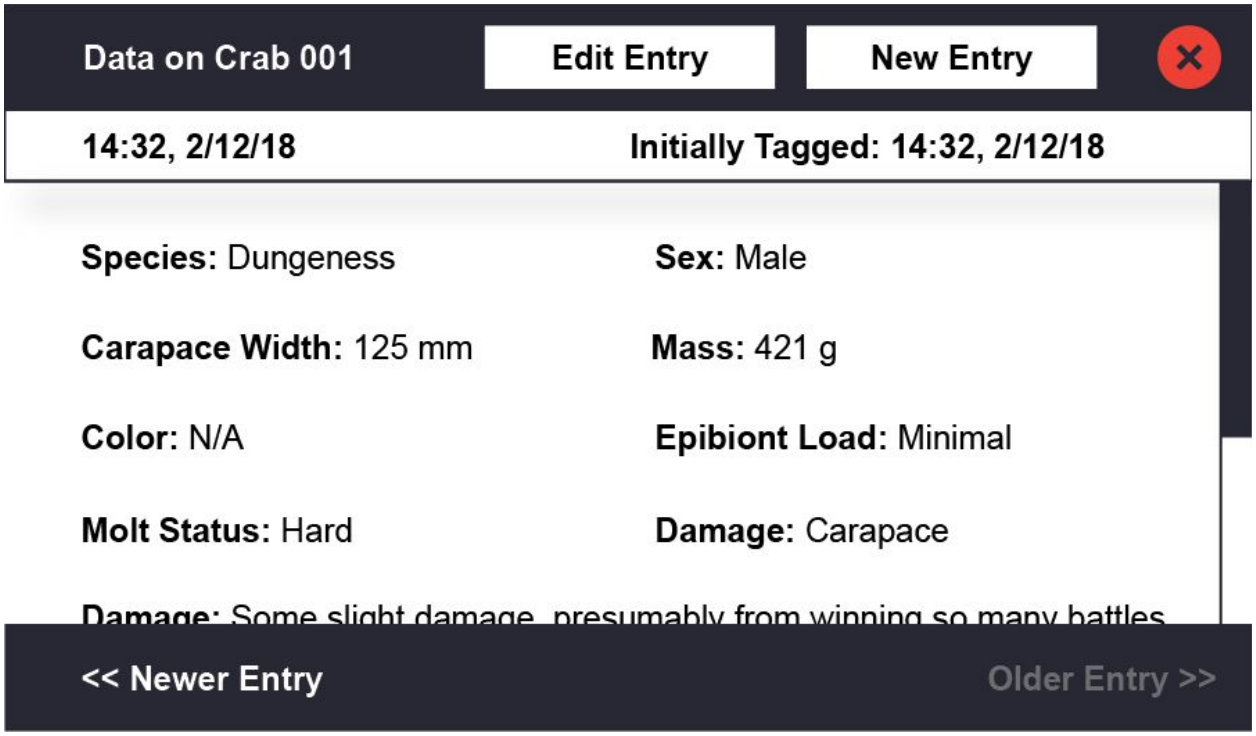


Figure 37. This is what the initial entry of data for a crab looks like. Again, you can edit it, but it also shows up in the entries section, despite having different info than the rest of the entries.