

1. Introduction

The UK has some of the best surf conditions in the world but can vary greatly from day to day. Conditions can be especially changeable due to the number of different beaches, with wind hitting them in various ways. In order for surfers not to waste time surfing at beaches with bad surfing conditions, surf forecasting has been developed to help predict surf conditions. This project aims to expand on the currently available sources of surf forecasting to try and develop a device that can predict surf at a more precise location. This device would read live data and give a changing view of how the surf conditions will be.

2. Aims & Objectives

Aim:

The aim of this project is to create a portable device that can predict surf conditions. It will collate data from any location and take readings of wind speed & direction in order to predict the average height of waves.

Objectives:

- Research into existing systems and methods of measuring data.
- Select appropriate components to achieve project goals.
- Design a system that will accurately collate live data and display a surf report based on incoming data.
- Build and test the device to ensure all systems are working as intended. Any errors to be fixed during this stage.
- Evaluate the results from finished design to determine if the project has been successful. Analyse areas that need changing and the overall successes and failures.
- Propose future improvements for how the overall performance of the device could be increased (based on previous evaluation).

3. Research

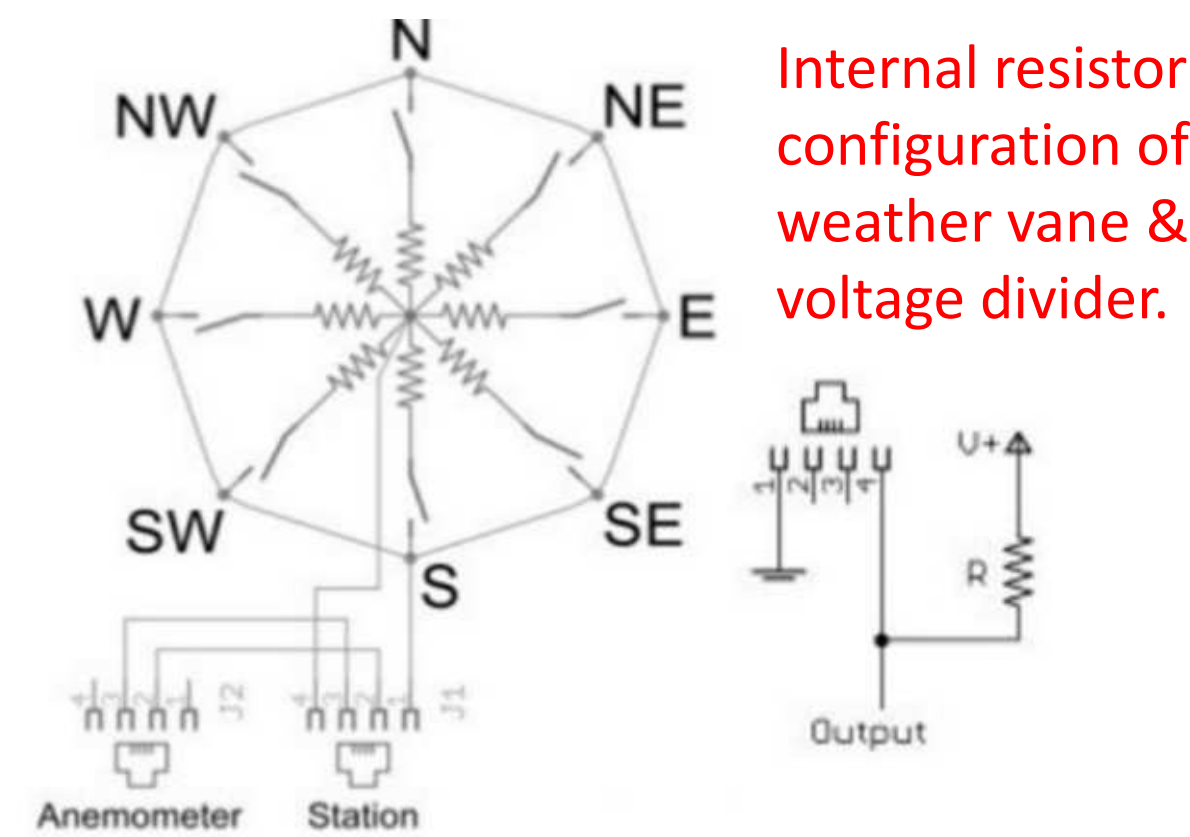
After research into currently available devices, the components used for this project are:

- **Anemometer:** An anemometer will be needed to measure wind speed. Very low wind speeds produce small waves and as it increases so does the size of the waves. Power from the wind is transferred into the ocean.
- **Wind vane:** This is needed to detect wind direction. Wind direction affects how waves are groomed and formed. Offshore winds produce the best quality waves.
- **PLC:** A PLC is needed to collect all data and use it in a manner that will output useful results. Changing wind speed and direction will affect the text output from the PLC.
- **HMI:** This is needed so that the surf report can be displayed and read by the user. Data from the sensors will be sent to the PLC and the output from the PLC sent to the HMI. This will also be used to switch between screens.

4. Design & Implementation

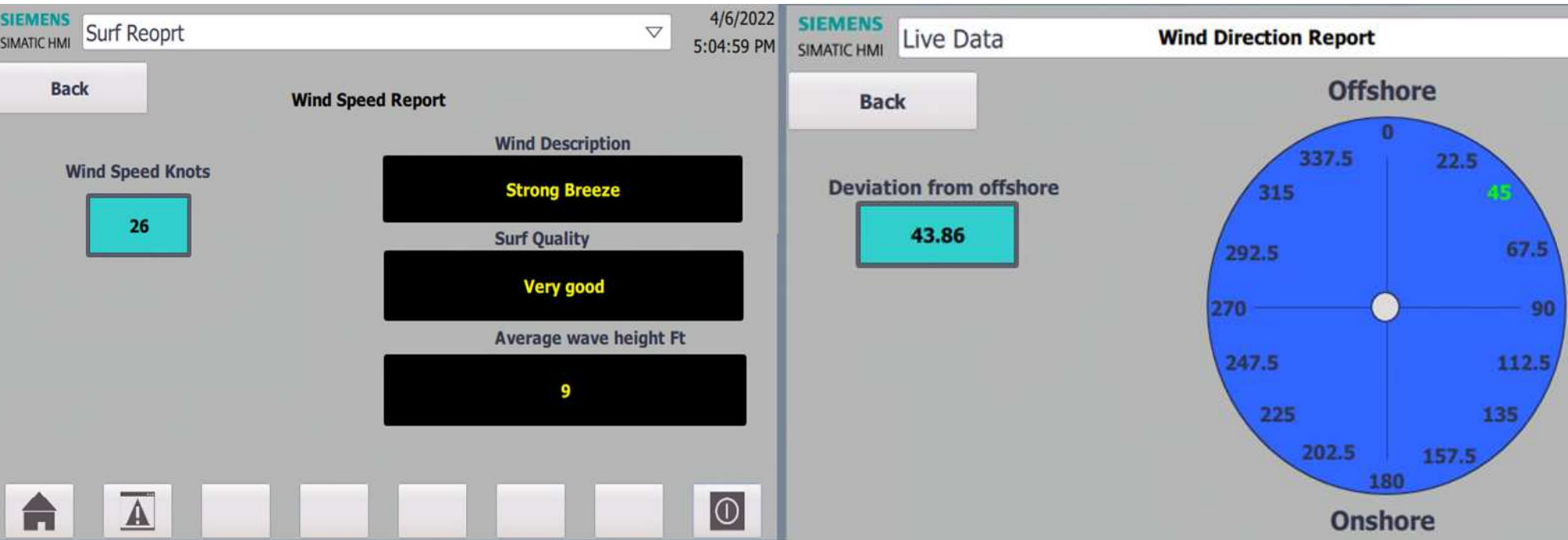
This system is designed using Siemens TIA V16 to create a ladder logic. For the anemometer a network is created that will count up every time a contact is closed. The number of these pulses in one second is divided by 0.67 to give a speed in mph. The figure of 0.67 is calculated from $\frac{1s}{1.492} = 0.67$ (1.492mph derived from the sensor datasheet).

The wind vane uses a series of internal resistors and switches to close up to two contacts, depending on the position of the vane (16 possible positions). Using an external resistor to create a voltage divider, the voltage at each position can be read and sent to the PLC.



With the ladder logic written, a HMI screen can be created for both the wind speed and direction reports. Data is taken from the Beaufort scale and then displays the average wave height as well as some other useful data on the HMI.

The HMI screen for “wind direction report” is used to display if the wind direction has deviated away from being offshore.



5. Results & Evaluation

During the testing of the final product the wind direction was found to be working as intended with the direction of the vane showing correctly on the HMI. The wind speed was correct to an accuracy of ± 1.19 mph. These were tested by checking weather reports at the test site and checking results against them. The prediction of wave height was not as expected and over predicted the size of the waves by 2ft on day of testing.

LANGLAND BAY SURF REPORT

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CURRENT CONDITIONS

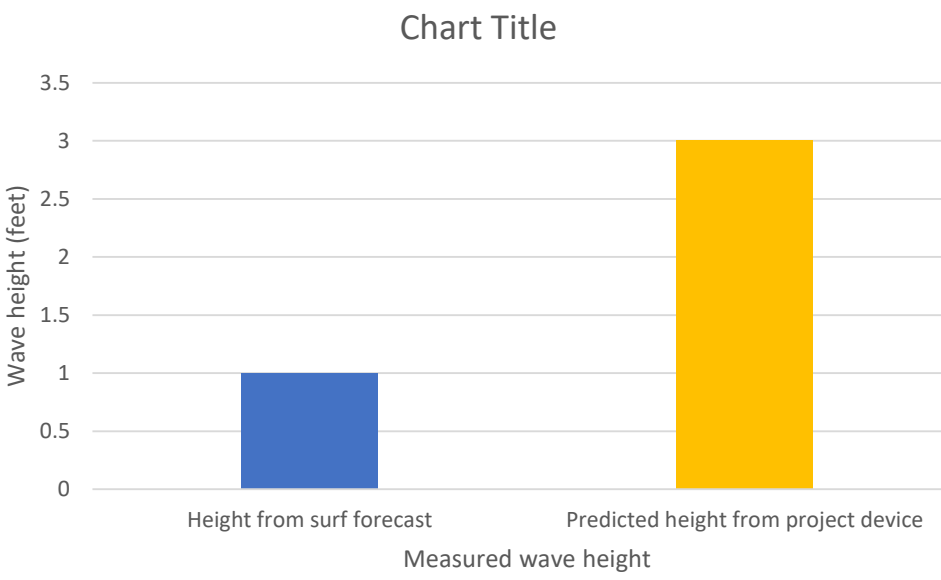
1ft 

15MPH MODERATE, CROSS/ONSHORE 

Primary Swell 0.9ft at 8s 

Secondary Swell 1.4ft at 3s 

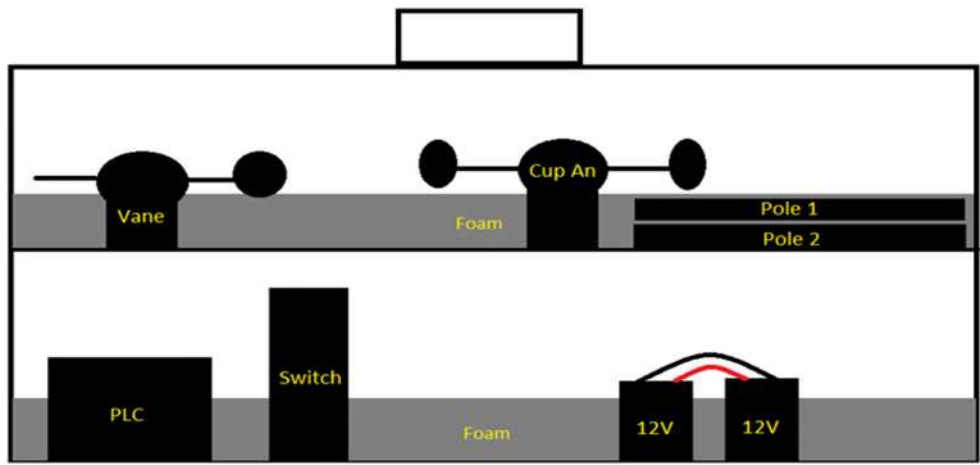
Air 11°C Sea 11°C



6. Future Research

In order to improve upon the design and performance of this project, the following additions could be made:

- Introduction of swell period to logic. Swell period defines the time between waves and affects the quality of surf produced.
- Improved case design. A smaller case could be utilised and components stacked on top of each other. This would save space and weight.
- Surf calculations. A surf calculation would tabulate the data from wind speed, direction, and swell (if added) to produce an overall rating out of 10.



7. Conclusion

- Overall the project was successful.
- Accuracy of wind speed & direction acceptable but some changes to be made to wave height.
- Quality of overall build could be improved for a future design.
- Topography of beaches could affect wave height. More research to be conducted to discover key aspects of this and how to use.

