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The design of an efficient wind direction measurement using digital positioning method for smart house

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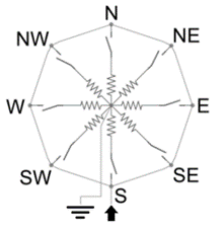
Abstract

The main purpose of this wind direction design is to produce the low price efficient wind direction measurement by using waste conductive material for smart house. We found that the input and output bit size is not necessary to equal the number of directions and it is able to be minimized and use simple electric circuit instead of integrated circuit. It is also reliable and easy maintenance. This paper shows the design of eight-direction design of measuring the wind direction by using 4-bit input and output which is consists of two plates, one is at the top plate and another one is at the bottom plate. The results are shown that 8 directions get different 8 values from 4-bit input which indicate different directions.

Keywords: Wind direction, Measurement, Digital positioning method, Smart house

1. Introduction

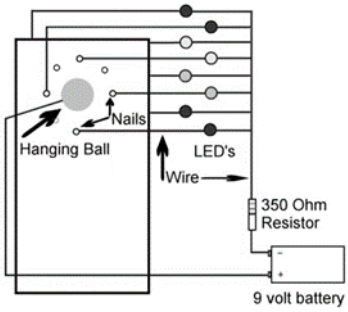
Wind direction is expressed in term of the direction from which it originates. For example, a northerly wind blows from the north to the south, and a southerly wind blows from the south to the north [1-2]. Wind direction is the most important variables for effective wind energy utilization [3]. There are many ways to design wind direction measurement such as wind vane voltage divider circuit [4-5] which is shown in Figure 1.



Angle (Degrees)	Resistance (Ohms)	Voltage (V=5v, R=10k)
0	33k	3.84v
45	8.2k	2.25v
90	1k	0.45v
135	2.2k	0.90v
180	3.9k	1.40v
225	16k	3.08v
270	120k	4.62v
315	64.9k	4.78v

Figure 1 Wind vane voltage divider circuit

The wind vane voltage divider circuit consists of a resistor array connected with eight magnetic reed switches. This produces one of 16 different voltage levels corresponding to 16 discrete compass directions.



Angle (Degrees)	Wind Direction	Reading (Binary)
0	N	01111111
180	S	10111111
90	E	11011111
270	W	11101111
315	NW	11110111
45	NE	11111011
135	SE	11111101
225	SW	11111110

Figure 2 Wind direction circuit switching

Figure 2 shows another design of wind direction circuit switching which digital values indicate position directly. The design of a circuit switching wind direction sensor [6] using a bit input. The output of particular section changes from

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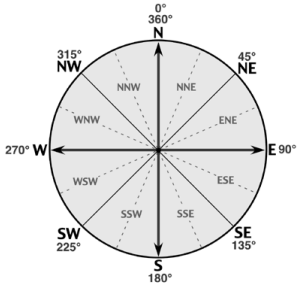
HIGH to LOW, while other 7 circuit remain at HIGH such as 01111111, 10111111, 11011111, 11101111, 11110111, 11111011, 11111101, 11111110 representing the eight cardinal points.

2. Wind directions with smart house

2.1 Wind directions

In the English compass, all wind names are constructed on the basis of the cardinal four names (N, E, S, W). The eight principal winds (or main winds) are the cardinals and ordinals considered together [7], that is N, NE, E, SE, S, SW, W, NW as shown in Figure 3. Each principal wind is 45° from its neighbour.



Abbreviation	Wind direction	Degrees
N	North	0°
NE	Northeast	45°
E	East	90°
SE	Southeast	135°
S	South	180°
SW	Southwest	225°
W	West	270°
NW	Northwest	315°

Figure 3 Compass rose with the eight principal winds

2.2 Smart house

Knowing what the weather outside is like and what it is likely to do in the future is a design factor in every home built today. Smart homes are designed to survive certain predictable events such as minor earth quakes, strong winds [8]. Simple automation, like opening windows when the air is cool or opening vents in the conservatory when the sun comes out, is becoming mainstream. Another application for state of the art home automation is remote building control and safety management with features such as controlling the vacant home including temperature, energy, gas, water, smoke, and wind [9].

3. Methodology

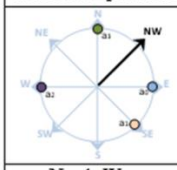
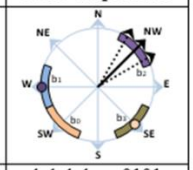
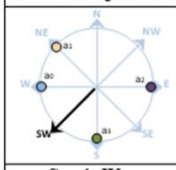
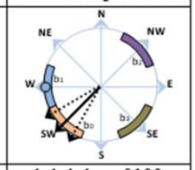
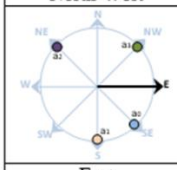
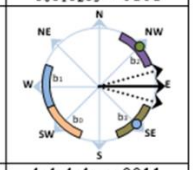
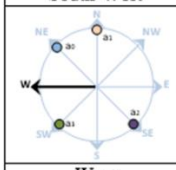
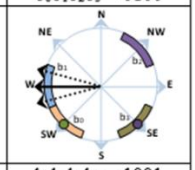
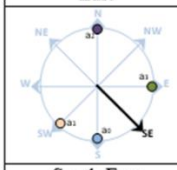
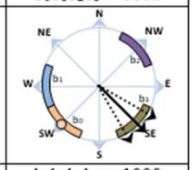
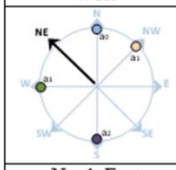
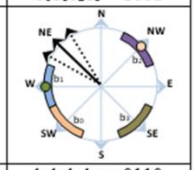
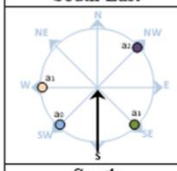
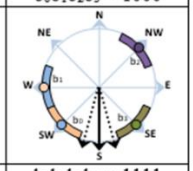
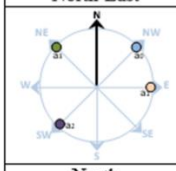
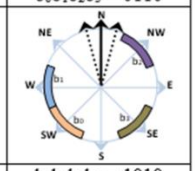
The wind direction measurement design consists of two plates, one is input at the top plate and another one is output at the bottom plate. The calculation of bit size for minimizing the input and output its size is shown in Table 1.

Table 1 Bit size and available directions

I/O bits	*Possible Design*	*Available Directions*	*Degree*
1	1	2	180
2	4	4	90
3	7	6	60
4	10	8	45

In this paper, we design eight direction of wind indicator. Hence, there are 10 possible designs that we can select. The possible designs of 8 directions are shown in Figure 4. In this case, we have selected the design No.7 for wind direction of eight cardinal points.

Table 2 Directions and output values

Movable Input Plate	Fixed Output Plate	Movable Input Plate	Fixed Output Plate
			
North-West	$b_0b_1b_2b_3 = 0101$	South-West	$b_0b_1b_2b_3 = 0100$
			
East	$b_0b_1b_2b_3 = 0011$	West	$b_0b_1b_2b_3 = 1001$
			
South-East	$b_0b_1b_2b_3 = 1000$	North-East	$b_0b_1b_2b_3 = 0110$
			
South	$b_0b_1b_2b_3 = 1111$	North	$b_0b_1b_2b_3 = 1010$

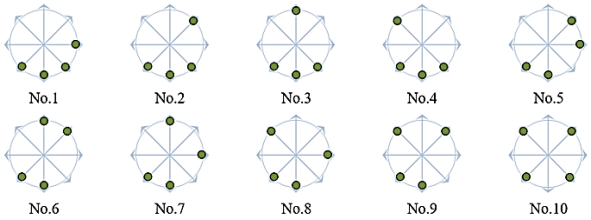


Figure 4 Ten possible design of eight direction indicator

4. Results and discussion

The input plate is movable and the output plate is fixed. The input is $a_0a_1a_2a_3$ with all HIGH and the output is also 4 bits ($b_0b_1b_2b_3$) and each direction has different output values which are shown in Table 2 to indicate the direction of wind (North-West = 0101, East = 0011, South-East = 1000, South = 1111, South-West = 0100, West = 1001, North-East = 0110, North = 1010). So, each value can indicate wind direction. For indicating the wind direction, we need different output. From the result shows the eight directions with the same input which vary outputs are given

5. Conclusions

An efficient wind direction using digital positioning method worked fine producing desired result for the direction tested. However more direction can be accounted by increasing the size of input and output bits and then we calculate possible designs and choose one of them to test available direction for minimizing the complexity. The output value should be different with the same input of all bits are HIGH in binary and the output should be different value at different direction. This wind direction design is suitable for smart house because it is simply, reliability and the enough direction degree for indicating wind direction. This can help save energy, make your home more comfortable and easier to live with.

6. Acknowledgements

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