

# **Design of a Circuit Switching Wind direction Sensor**

by

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## EXECUTIVE SUMMARY

TAHMO initiative has inspired the design of an efficient circuit switching wind direction sensor from waste material such as straw, compact disc, stick, waterproof cardboard and aluminum foil; because of the need to design a sensor that can measure a weather or hydrological variable in Sub-Saharan Africa which is both inexpensive and robust.

Like the standard wind vane but employing an innovative method; the circuit switching wind direction sensor is made up of a triangular structure and rectangular structure cut out from a water proof cardboard. The triangular and rectangular structure are connected by a straw and held on a central axis with a pin where it is free to rotate with highly negligible friction. When wind blows, the structure rotates to minimize air resistance and thereby points in the direction from which the wind is blowing

In other to capture the wind direction, a light wire with the shape of a small letter **n** is attached to the freely rotating straw, where it can close 1 of 8 open circuits representing 8 cardinal directions (N, S, E, W, NS, NE, SW, SE) depending on the direction of the wind at any point in time. The default voltage output of each open circuit which is pulled up by a resistor when it is not closed by **n** shaped wire is 5v or HIGH. However, when it is closed by the **n** shape wire, it has a voltage level of 0v or LOW. Readings are taken from the 8 output representing 8 bits by a microcontroller at regular interval and the direction of the wind is determined

The cost of construction falls below \$1 for production of 20,000 unit of the sensor, the sensor was tested and worked fine.

## 1.0 Design

As shown in the figure 1 below, the general concept is the ability to make the wind direction close up just 1 of 8 circuits at any point in time, based on the direction in which the wind is blowing from. The 8 circuit are taken to a default 5v by a pull up resistor and the inputs are fed into a microcontroller. One part of the **n** shaped wire is constantly connected to ground or 0v via a moveable ball joint, irrespective of the direction of the wind while the other part of the **n** shaped wire can switch through or make contact with any of the 8 circuit based on the wind direction via a movable ball joint. When a circuit is completed, the microcontroller input of that particular section changes from 5v to 0v, while other 7 circuit remain at 5v. When read by the microcontroller as 8 bit, one of readings such as 01111111, 10111111, 11011111, 11101111, 11110111, 11111011, 11111101, 11111110 representing the eight cardinal points (N, S, E, W, NE, NW, SW, SE) is generated as indicated by table 1.

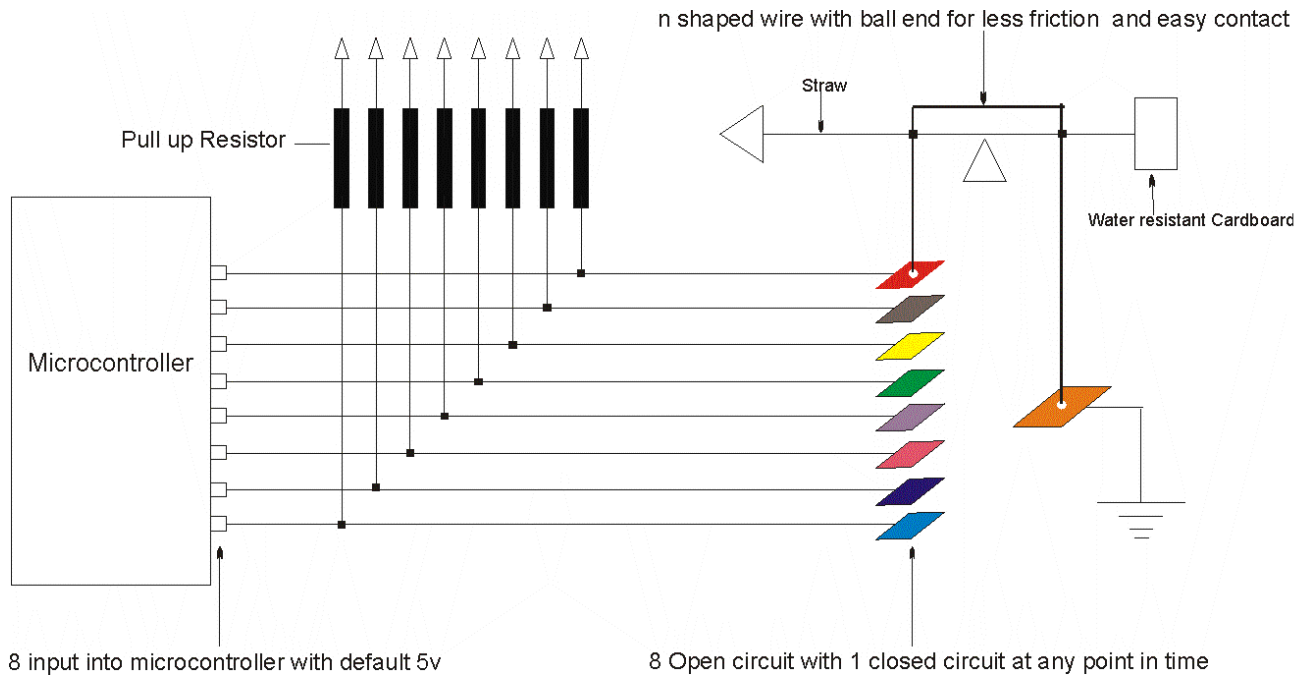


Fig 1: Circuit representation of the circuit switching Wind Direction Sensor.

### 1.1 Wind Direction.

According to Wikipedia (2014) the wind direction is the reported by the direction from which it originates. The directions are gotten through the use of a compass and are assigned. However they can be reassigned in the microcontroller program when required

Table 1. Wind Direction and Matching

Reading	Wind Direction	Angle
01111111	N	0 <sup>0</sup>
10111111	S	180 <sup>0</sup>
11011111	E	90 <sup>0</sup>
11101111	W	270 <sup>0</sup>
11110111	NW	315 <sup>0</sup>
11111011	NE	45 <sup>0</sup>
11111101	SE	135 <sup>0</sup>
11111110	SW	225 <sup>0</sup>

## 1.2 The Disc Setup

The Compact disc is partitioned into 9 different segments by placing an aluminum foil on the disc and dividing into 9 different sections by a very thin line. 8 sections are connected via a wire attached to the pull up resistor to the microcontroller to form 8 circuits representing 8 cardinal points. The center part is connected to ground as shown in fig 2 and 3 below

8 open circuit representing 8 cardinal point arranged on a Compact disc with the ground at Middle.

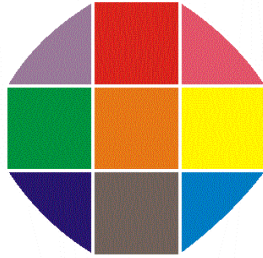


Fig 2. Showing division of the aluminum foil on the compact disc to 9 segments

## 1.3 The n shape wire and Ball joint.

The **n** shaped wire is chosen to be a very light wire such that any point of rotation, one part remains fixed on ground through the free and movable ball joint and the other switch between 8 segment circuit. The little friction experience by the ball and aluminum foil is compensated by increasing the size of the triangular and rectangular waterproof cardboard, to allow more wind to apply force on the larger area as shown in fig 3.

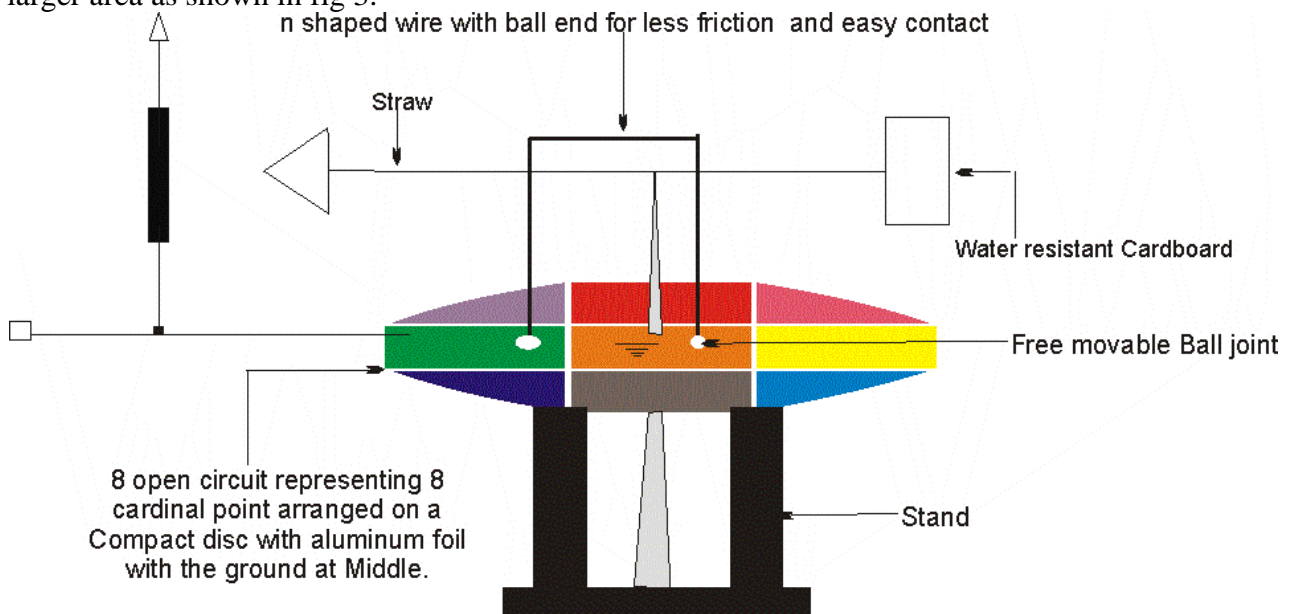


Fig 3. Setup of circuit switching Wind Direction Sensor.

**Table 2. Component Cost Analysis**

<b>COMPONENT</b>	<b>PRICE (USD)</b>	<b>QUANTITY</b>	<b>TOTAL</b>
Water resistant Cardboard	0.12	5	0.12
Straw	0.006	2	0.006
Pin	0.006	1	0.006
LED <b>Red Light</b>	0.03	1	0.03
Compact Disc	0.3	1	0.3
Aluminum foil	0.18	1	0.18
Sensor Stand	0.12	1	0.12
<b>Microcontroller</b>	1.2	1	1.2
Resistor <b>220 ohms</b>	0.03	9	0.27
Connectors <b>Connecting Wires (100cm)</b>	0.5	1	0.5
<b>TOTAL</b>			<b>2.732</b>

\* Prices are sourced from local electronic stores and are expected to be cheaper when sourced from manufacturing company

## 1.4 CONCLUSION

The circuit switching Wind Direction Sensor worked fine producing desired result for the direction tested. However more direction can be accounted for by increasing the circuit from 8 to 16.

## 1.5 REFERENCE

Wikipedia (2014) "Wind Direction",  
[http://en.wikipedia.org/w/index.php?title=Wind\\_direction&oldid=535574574](http://en.wikipedia.org/w/index.php?title=Wind_direction&oldid=535574574)" 2014.