REDESIGNING THE MOTORWAY WINDSOCK IN MALAYSIA

ANTHONY MAN LEONG WONG, ABDUL MUAIZ AZMAN, ABDIL ADZIM MD SOKI, CHEE WENG KHONG
Interface Design Department, Faculty of Creative Multimedia, Multimedia University, 63100 Cyberjaya, Malaysia
{mlwong@mmu.edu.my, aamuaiz@yahoo.com, adeezim@yahoo.com, cwkhong@mmu.edu.my}

Abstract. According to the Malaysian police statistics, quite a number of road accidents recorded in Malaysia are caused by crosswinds. This is especially so for accidents occurring on the motorways (highways), in hilly areas and in the east-coast during the monsoon season. Presently, Malaysian authorities address this issue by placing crosswind warning signs on the roads to ensure the safety of the motorist in these areas. However, the crosswind warning signs used on the Malaysian highway are of the old-fashioned windsock kind which is no longer effective in present time. The windsock's visibility at night or in bad weather conditions is nearly close to zero. Thus, motorists on the highways are often unaware of the presence of the windsock and fail to notice it while passing by at a speed of more than 80 km/h in poor weather conditions. This paper highlights the redesign of the windsock to increase its visibility, thereby enhancing its presence significantly, and to relay real-time information to motorists on the highway. The enhanced design should be able to detect wind directions, wind speeds and wind duration. This paper will also highlight the use of the re-designed windsock in simulations of extreme weather conditions.

1. Introduction

Windsocks are commonly used at airfields and can be found alongside highways. Sometimes they can be found at chemical plants where there is risk of gaseous leakage. The 4 main purposes of a windsock are:

i) To detect wind direction,
ii) To estimate wind velocity,
iii) To determine gas leakage spread area at chemical plants, and
iv) To help in directing boats and yachts in sailing.

It is proven to be a useful, cost efficient way of reducing the number of accidents caused by crosswinds. Typically, a windsock's construction consists of:

i) a vertical pole which is called a mast. This is usually made of painted galvanized steel, mild steel or stainless steel,
ii) a swivel head on top of the mast that allows the windsock to revolve around according to wind direction,
iii) a hollow, coned-shaped PV cloth or polyurethane coated nylon material which is lightweight enough to stretch out fully when the wind blows, and
iv) a wire attaching the windsock to the mast.

The cone section is divided into several segments whereby every segment represents a certain wind speed. According to the FAA (Federal Aviation Administration) standard, a typical windsock requires a 15 knot (17 mph) of wind speed to fully extend the windsock while a 3 knot (3.5 mph) breeze will cause the windsock to orient itself according to the wind.

2. Motorway Windsocks in Malaysia

There are 3 crosswind-prone areas along the Malaysian highways where windsocks are provided as warning aids:

- Senawang–Pedas/Linggi on North-South Expressway Southern Route,
- Alor Gajah–Ayer Keroh on North-South Expressway Southern Route,
- East Coast Expressway.

Even though windsocks have been used in various aspects, all of them share the same basic principles and engineering. Nevertheless there are some small differences or extra features among them. For example, Figure 1 shows the aviation windsock (on the right) which integrate spotlights or floodlights to light up the windsock at night. This feature has not, however, been implemented in windsocks (on the left) that are used on Malaysia highways.

The biggest weakness of the motorway windsock is that the visibility of the windsocks at night or in bad weather conditions is nearly close to zero. Thus, motorists on the highways are often unaware of the presence of the windsock and fail to notice this warning sign while passing by at a speed of more than 80 km/h in poor weather conditions. Also, the colour of the windsocks may have faded due to exposure to the elements and environment over the years. This makes it difficult for motorists to determine the indication shown by the windsocks, even in the daytime.

Figure 1. Typical motorway windsock (left) and aviation windsock with spotlights.

3. Method

3.1. ONLINE SURVEY

In this study, all respondents were requested to provide their opinions in their preferred language in an online survey about the motorway windsocks in Malaysia. The use of preferred language was to enable the respondents to express their views and ideal solutions. The target respondents were motorists who often used the highway in their daily lives whether by car, motorcycle or motor truck. They were randomly selected based on different kinds of vehicles used, so as to provide more precise results and opinions without bias.

3.2. RESULTS

Most of the respondents pointed out that the current situation is lacking in clear visibility of signage and more sophisticated devices should be located at the 3 crosswind-prone areas to cater for night-time or bad weather conditions. The following are some common suggestions and user requirements obtained from the online survey:

- digital displays showing the real-time maximum speed at which a vehicle should be driven in line with the existing wind conditions,
- warning signs that are placed well ahead of the crosswind-prone areas,
- considerably larger signboards
- sufficient lighting at the crosswind-prone areas,
- a more modern, highly visible crosswind indicator.

3.3. DESIGN PROCESS

The suggestions from the respondents were compiled as the useful guidelines for the design process of redesigning the windsock. Figure 2 shows the perspective views of the proposed windsock. There are 4 main parts in this design which involves the windcone, tail, LEDs (light emitting diodes) and the pole.

3.3.1. Windcone

The windcone section is attached to the pole with a built-in ball bearing section, thus allowing it to freely revolve at 360 degrees. The windcone is designed to be able to align itself towards the wind, and there is a built-in fan within it. The fan will spin according to the wind speed, i.e. it will spin faster if the wind is stronger.

3.3.2. Tail Section

The tail is attached on the windcone to give an indication of wind direction. There are strips of red LEDs that are waterproof and ultraviolet (UV) resistant that is mounted on to the tail section to provide motorists with an easy way to view the direction of the wind.

3.3.3. LED Compartment

Three colours of LEDs are used, that is red, yellow and green, and the LEDs are weather resistant. The LEDs will provide adequate illumination up to 500 meters. The LEDs and the built-in fan are both connected to a dynamo. The electricity generated by the wind will provide current to a circuit board for lighting up the necessary LEDs, thus informing motorists of the present wind speed.

3.3.4. Pole

The pole is the mast and this is used to hold the windcone section and the LEDs' compartment.

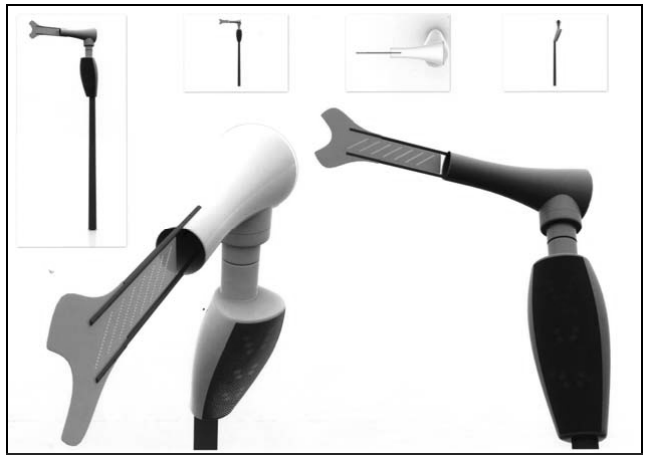

Figure 2. The perspective views of the proposed windsock.

4. User-Centred Design

4.1. VISUAL INDICATION

The existing LEDs play an important role in the application of the windsock. They are used to convey clear instructions to motorists from afar. The three colours of LEDs proposed in this study are somewhat similar to those on a traffic light, which is intended to provide the same cognitive information. To avoid confusion to motorists who may mistake the windsock as a traffic light, this study proposes to position the red LED at the bottom and the green LED at the top. Table 1 below defines the LEDs' colour combination and the intended motorist's actions.

TABLE 1. Definitions of the LED colour combinations for the proposed windsock.

COLOR COMBINATION	DEFINITION/MEANING	ACTION
Green	Idle, no wind	Drive at normal speed
Green + Yellow	Be cautious, intermediate wind	Drive carefully
Green + Yellow + Red	Dangerous, strong wind	Danger, Beware

Figure 3 below shows the proposed windsock and its various LED colour configuration.

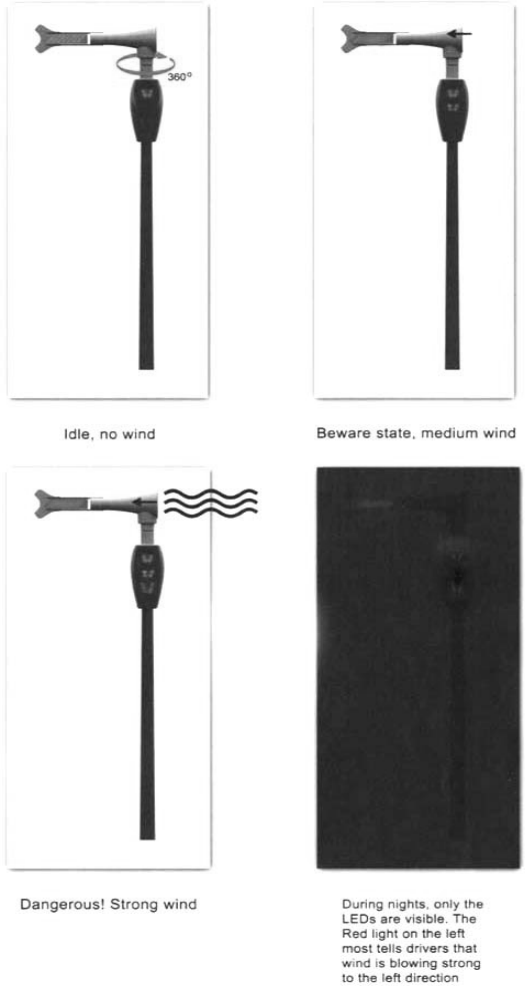

Figure 3. LED and colour indication of the proposed windsock.

4.2. SIMULATION AND TESTS

During the design and development of the proposed windsock, several real-time simulations were conducted to obtain feedback from motorists. This method of evaluation allows for user-centred design in the hope of producing a better device-oriented solution. A simulation screenshot of the proposed windsock is shown in Figure 4.

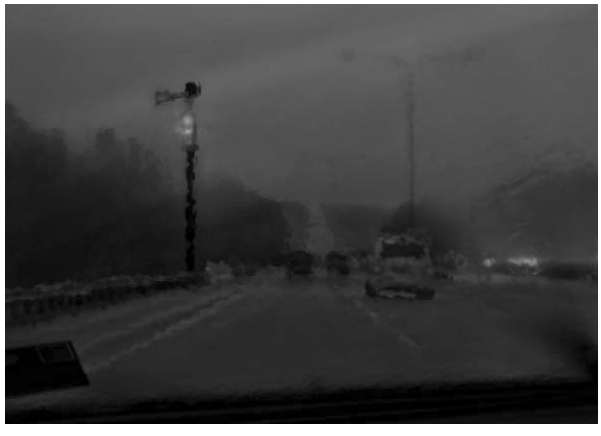

Figure 4. Simulation screenshot of the proposed windsock under poor weather condition (motorist's viewpoint from within the vehicle)

4.3. BEYOND PHYSICAL DESIGN

As information is gathered in real-time by the proposed windsock, it is also proposed that the information to be relayed to motorists on their GPS devices and cellular handsets, especially to those who are approaching the crosswind area. Crosswind information gathered from the proposed windsock is transmitted to the nearest relay station, weather monitoring station, and to the national meteorological department.

This life information is sent out to several providers' gateway which is then provided to the users via SMS (short messaging service) and MMS (multimedia messaging service) broadcast over GPRS. In the near future, users who subscribe to GPS navigation in the country will also receive an auditory alert and a visual cue on their respective devices highlighting the crosswind area.

This study is presently moving forward in developing proposals for the crosswind information to be viewed on the screens and displays of various handheld and portable devices.

5. Summary

The existing motorway windsocks in Malaysia are old-fashioned and no longer effective in present time. Thus a new system of crosswind warning system is needed to ensure the motorists' safety.

The feedback from respondents is very clear that the new system should provide them with a great visibility of the warning or message. They prefer visual-based information that can be seen from a distance as these can help them determine their next course of action prior to passing through the crosswind-prone area.

The authors also recognise that there is a need for further investigation with the possibilities of cooperation from the Ministry of Science, Technology & Innovation (MOSTI) to record strong gusts of wind in real-time and to relay this information to local traffic controllers and weather bureaus in the country. Such an exercise would allow motorists to have access to greater visual identification provided by the enhanced tracking of data relayed by the new windsock design.

References

2006, *Understand More About Toll Roads.* From: http://www.4896kj.com/4896/understand-more-about-toll-roads-in/2006/12/19/

Malaysian Police Department: 2007, *Traffic Statistic*. From: http://www.rmp.gov.my/rmp03/

Ministry of Science, Technology & Innovation (MOSTI): 2007. From: http://www.met.gov.my/home_e.html

Online Survey: 2007. From: http://www.zoomerang.com/survey.zgi?p=WEB2267JHR9H24

Lembaga Lebuhraya Malaysia: 2007. From: http://llmtrafik.gov.my/index.aspx

U.S. Department of Transportation, Federal Aviation Administration: 1985, *FAA Specification for Wind Cone Assemblies*. From: http://www.faa.gov/airports_airtraffic/airports/resources/advisory_circulars/media/150-5345-27D/150_5345_27d.pdf.

Wikipedia: 2007, *Malaysian Expressway System. From* http://en.wikipedia.org/wiki/Malaysian_Expressway_System