Wind Sensitive Auto-controlled Poster Billboard

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Abstract

This is a system for automatic rolling up, rolling down and wind sensitive poster billboard. It has a microcontroller system that serves as the processing unit. It features an improvised anemometer unit with an IR sensor responsible for measuring wind speed and a geared motor with a shaft secured at the upper side of the rolling tube that rotates clockwise and counterclockwise. The system has a servo motor for the poster billboard locking/unlocking mechanism placed at the upper part of the frame. The initialization system is connected to the said microcontroller defined by a keypad unit. And a liquid crystal display (LCD) screen is attached to the said microcontroller which display output characters and information from processed data of the said system. It also has a halogen flood light for lighting, a switching relay, a single faced poster billboard canvas. It has a piezo-buzzer for a sound indicator, a wooden frame for the poster billboard with guides for the rolling of tube placed on both sides. The developed system was subjected to product evaluation in terms of functionality, reliability and correlation. It was found out that developed system has 96.30% rating in terms of functionality and reliability after six days of testing. Hence, the developed system is technically feasible and can resist wind and typhoon. However, further studies is recommended for enlarge size of the billboard panel/canvass.

Keywords: poster billboard, typhoon proof billboard, auto-controlled billboard, wind sensitive billboard

I. INTRODUCTION

Xu (2012) said that billboards are used as a device to transmit advertising information to the public, and according to different needs, they too can be made into various forms. There are billboards that are established on transport corridors and transport hubs. The stents of the billboards are usually supported on a single column or multiple columns. If based to the billboard face, they can be divided as single-faced, double-faced and multiple faced. Because such billboards have simple structure, easy production process and can attract the attention of passers, the billboards are widely used.

The usage of billboard advertising strategy has been in existence for some

decades until now. During the 20th century, the increasing use of vehicles rapidly resulted in companies employing billboard advertising to air a broad range of goods and services. On the contrary, there is a misconception that due to the emergence of several other advertising techniques in the market, the effectiveness of billboard advertising has lessened. However, billboard advertising strategy has certainly proven to be beneficial for several businesses around the globe, Rampur (2005).

Consumer who goes around from one place to another is hard to catch, but Billboard advertisements catch him in every place with effective reach. Due to this reason Billboard Advertisements are preference for advertisers and marketers (ISIMD,2005).

There are a number of reasons for the recent surge in billboard advertising, not the least of which costs efficiency. Compared to other forms of advertisements, billboards are a relatively inexpensive way to get your point across to the general public (www.gaebler.com/Billboard-Advertising-Costs.htm).

Consider this: A newspaper advertisement is only good for a day and television commercials only lasts about 30 seconds. But a billboard advertisement is working for you 24 hours a day, seven days a week (www.gaebler.com/Billboard-Advertising-Costs.htm).

In the Philippines, the cost of a billboard advertisement is Php200,000.00 per month, says Joel Callao, President of outdoor-media supplier Media Pool (Dy, 2005). A full color, full page advertisement in a major daily newspaper would cost approximately P 250,000.00 on weekdays, andPhp300,000.00 on weekends. A 30 seconds primetime slot on a major local channel, meanwhile, would run about Php180,000.00 (Ibid).

Meanwhile, problems and issues on billboard advertisements had been encountered mostly during typhoons. It brought dangers and accidents that almost destroy properties and lives of several people. On September 2006, typhoon Milenyo with the speed of 160 Kph brought a great destruction in the country. Twenty-five billboards lay toppled and one of the giant billboard blocked the west side of the service road just before Bicutan. (Rivera, 2006). Same happened from the recent typhoon Pedring, which tore off billboards and caused a rare storm surge in Manila Bay. (Francisco, 2011) Such disaster caused a great waste on billboard installation cost and effort.

Besides of billboard advertisement effectiveness, the study identifies the main problem with regards to its structure, components and its concern towards people.

During bad weather, billboards are usually prone of trapping a great surge of air pressure. As the air act against the billboard panel, the trapped air contributes a force sufficiently enough to bring down columns and frames that will totally destroy the billboard structure that may bring into risks and danger.

In this case, the efficiency of billboard advertising is greatly affected. The cost on its installation, the appearance of texts and pictures, the longevity of its public appearance, the preference of advertising company, and the people's safety are also affected.

The study aimed to develop a system that provides an automatic rolling up/down windproof poster billboard. Specifically it aimed to: 1) Develop the device with regards to its system hardware, system software, and prototype poster billboard structure; 2) Evaluate the product in terms of functionality and reliability.

Prior Art Search

Some study regarding with the storm or windproof billboard has already been developed, and almost of them has been patented. The following are nearest prior art billboard to the present study:

Roadside Stormproof Billboard According to this Chinese patent, Publication No.CN2760701Y this patent claims: In use, under the wind force, the billboard panel rotates with respect to the column; it has a restoring spring compress to form a torque under the wind force. Otherwise, the billboard panel is reset, and the torque is released under the force of the restoring springs when the wind force is reducing. Its disadvantages are: 1.) the billboard will rotate even there is slightest wind, deviating from the best direction; 2.) the restoring speed of the billboard panel is slow; 3.) and the billboard panel cannot complete the wide angle turn(http://www.patentstorm.us/applications-by-date/2010/0128/1.html).

With its conclusion, the use of the billboard panel cannot be in the best direction so that the advertising effectiveness is affected.

Anti-Wind Billboard. Another study is the unloading method of the wind load according to Chinese patent, Publication No. CN100390838C. By using this structure, the windward side of the billboard can be changed to a certain extent for unloading the wind load of the billboard. However, the billboard also has shortcomings. First, the control system of the control method simply monitors the real-time wind speed, when the wind speed is greater than the security value. The wind direction is in parallel with the billboard. The system still sends the rotation signal to the laminas of the billboard, but this is unnecessary. In the process of adjusting laminas angle, because the rigid mechanical drive always exists, the wind load is always transferred to the billboard stent. In bad weather where the wind speed is very unstable, in the process of adjusting laminas if the wind speed increases instantaneously, the system can not make the corresponding adjustment. The billboard may be damaged by wind. Second, along mechanical part, because of the louver structure, the movable parts are complex. And because the billboard panel is not whole, images are sprayed or consist of plural screens. It makes the image effect bad. Its maintenance and replacement are also very troublesome according to Ningbo (2010).

Storm Proof Billboard and Control Method. US Patent Application 20100018098 – Stormproof billboard and control method by PeiyuanXu, Ningbo, this invention provides a storm proof billboard. It comprises column, wherein a pedestal is disposed of on a top of the column. It has a rotating element disposed of between the rotating table and the pedestal so as to make the rotating table rotate with respect to the pedestal. There is a motor disposed of on the column and driving the rotating table to rotate by a driver gear. An electromagnetic brake disposed on the column to lock the rotating table is provided. It has an anemoscope measuring a wind speed and a trigger switch disposed of between the rotating table and the pedestal to measure that whether the rotating table aligns with the pedestal. It features an electric control assembly respectively connecting with the electromagnetic brake. And the motor, the anemoscope and the trigger switch, wherein the electric control assembly controls working of the motor and the electromagnetic brake by a signal of the trigger switch and a wind speed signal measured by the anemoscope. Among of the three patents, this was the nearest prior art to the present development of Ningbo (2010), Storm Proof Billboard and Control Method.

Same with the present study, the three claims have an objective that is to provide a windproof billboard. Some of its materials have similarities with the present project. It only differs with the reaction of the billboard rotation and the added features on it.

II. MATERIALS AND METHODS

The project used a system device that control the motor's rotation clockwise and counter clockwise. The motor disposed of at the upper side of the frame connecting the motor shaft into the cylindrical tube with tarpaulin canvas.

An improvised anemometer with photodiode sensor connected to the system was used for measuring the wind speed which was converted into an electronic signal. When the anemometer rotated correspondingly to the speed of the wind, a signal was sent into the microcontroller for counting and reading the rotation per minute. When the detected value of the wind speed was equal or greater than the set value in the system, the billboard rolled-up automatically. Otherwise, after 30 minutes of comparing the wind speed, it would roll down when the wind speed reading was less than the set wind velocity. The speed of the wind was determined using the Beaufort Wind Scale Standard.

The developed project was a stand-alone device which did not need to use a computer for operation, but rather a microcontroller controlled the operation of the system.

This project also featured a lighting automation which provided an automatic switching On/Off of light during night and day, through an electro-mechanical relay connected to the microcontroller.

The Beaufort wind scale is an international scale of wind speeds indicated by numbers ranging from 0 for calm to 12 for hurricane. Each force is recognized by its effects on things such as flags and trees and the surface of the sea (Microsoft Encarta 2009). In this study, this will serve as a basis for identifying the wind speed collected by the sensor.

III. RESULTS AND DISCUSSION

Product Evaluation Result

The product underwent series of tests in order to determine the system's functionality and reliability.

Functionality Test Result. The test performance of every component was conducted fifteen (15) times to identify whether they were functional or not. These include the rolling up/down of the poster billboard and the anemometer sensor measurement of wind speed. The lock mechanism of the servo motor, the functionality of keypad users interface, the display of the LCD, the reset button, the light automation, and the system itself were also considered. The respondents were the project developers, the board of panelists, ECE Instructors and Advisers, and ECE Students. These tests were conducted in Project workplace, ECE laboratory and SSU College of Engineering.

The functionality test result was recorded after the series of tests, showing the different questions to be answered and the total number of frequency for each of it whether it was attained or not. Together with the frequency distribution, was also its equivalent percentage to be able to rate each function of the device.

The functionality test shows:

1. 100% it tells that initialization procedure of the device was executed.
2. 15 out of 15 series of tests were

Table 1. First Five Minute Records of gathered wind Speed in kph

Xi	X2	Yi	Y2	X	Y	XY
36	134.56	36	148.84	11.6	12.2	141.52
32	57.76	40	262.44	7.6	16.2	123.12
29	21.16	14	96.04	4.6	-9.8	-45.08
18	40.96	22	3.24	-6.4	-1.8	11.52
7	302.76	7	282.24	-17.4	-16.8	292.32
Σ = 122	557.2	119	792.8	0	0	523.4
Average = 24.4	111.44	23.8	158.56	0	0	104.68

successfully executed upon rolling up/down the poster billboard both manual and automatic operation.

3. The anemometer output response to the LCD output was 86.67% rating.
4. 93.33% tells that the servo motor execute during the locking and unlocking for the billboard due to its unsynchronized with the program.
5. The keypad performed its functionality with the rating of 100%.
6. LCD screens 86.66% displays the appropriate information when device was operated due to the improper connection of the wires, but on the last test it performed its function.
7. 15 out of 15 tests were successfully executed upon resetting the reset button.
8. The light automation executed its operation both manual and automatic operation.

After conducting the functionality test in 15 consecutive series, the study produced a rating of 96.30% with regards to the functionalities with different components same with the system device.

Reliability Test Result

The device was tested to find out if the consistency was doing a successful output when operated. The study conducted a series of repeated tests of operation on six consecutive days (from March 6-11, 2012) with a corresponding time of different time span. The results of each trial were recorded on reliability test result table.

From the result, the reliability of the device was rated according to the given operations:

1. ***Day 1*** - the system only performed its operation within 15 minutes due to instability of circuit wire connections. At that time, the system was still on its state of troubleshooting.
2. ***Day 2*** - after solving the problem on the previous day of observation, the system did not attain an operation that lasted for an hour due to another circuitry problem.
3. ***Day 3*** - the system was fixed the system operated for 3 hours of operation. It was done during a class demonstration, since the hour was limited; it was only recorded for 3 hours of operations.
4. ***Day 4 to Day 6*** - the system device has attained its full functions by operating it for a long span of time, performing the desired inputs and outputs of the user.

As the respondents continue to conduct a series of tests with the device, it was found out that it provided continuous and normal operations. Minor failures were experienced such as inappropriate display

of characters in LCD due to instability of wire connections towards LCD module. Another one was the problem of wind speed reading by the anemometer due to improper insertion of wire to the ports.

Correlation Test. The test covered for the improvised anemometer sensor output and its comparison with the standard anemometer used in PAG-ASA Weather Station in Catbalogan. By synchronizing the time of reading, one person was designated to record the wind speed read by the PAG-ASA, the same procedure with the reading of the system device. During this test, the independent variable here was the time while the dependent variable was the wind velocity.

From the 30 minutes recorded velocity of the wind, the respondents took five consecutive samples of every single (1) minute based on the reading. It got the summation and the correlation of the two wind instruments. Table 5 was the first five minutes records gathered wind speed.

Based on the computation from the gathered data, the association between the two variables had a strong positive correlation with r = 0.8.

V. CONCLUSIONS AND RECOMMENDATIONS

Based on the development and evaluation conducted, the following were derived from the study:

1. The system design of the project was successfully attained with regards to its phases of operation; the initializing process, the rolling up/down of the billboard and the lighting automation.
2. The development of the product was successfully achieved, in terms of its hardware and software, which needed to be complemented together.
3. The device attained the intended functionalities and successfully passed the reliability test based on the evaluation test conducted.
4. There were recorded limitations of the product, through the conduct of direct observations. These were the following:

    4.1. Calibrated Improvised Anemometer
    4.2. Poster Billboard Size
    4.3. Small Size Geared and Servo Motor
    4.4. Small LCD Size
    4.5. Wooden made Structure/ Frame
    4.6. No Back-Up Power
    4.7. System Needs to set up every time the initializing its operation.

Conclusions

The following conclusions were drawn from the study:

1. The development of the system for automatic rolling and rolling down the poster billboard was technically feasible.
2. The phases of operation of the system have been achieved considering its hardware, software together with billboard structure.
3. The device has passed the functionality and reliability test done by the researchers.

Recommendations

Based on the foregoing conclusions, the following recommendations were drawn for the future development:

1. Conduct a further study in order to enhance the system device and its design regarding the automatic rolling up and rolling down the billboard during typhoon with regards to:

    1.1 The strength and rigidity of

the structure against wind, and

1.2 The calculation of the bill board panel area with respect to the air pressure acting upon it.

2 Conduct a future development of the device. Specifically:

2.1 To provide a standard anemometer sensor

2.2 To enlarge the size of the billboard panel/canvas

2.3 To increase the operating specification of the two motor.

2.4 To use a bigger LCD Screen Display

2.5 To make the frame or structure rigid.

2.6 Incorporate a battery for the device for continuous operation.

2.7 To use an RTC module for storing the real time clock of the system.

2.8 Sealed the motors against corrosion from moist and temperature changes and,

2.9 Provides more secure lock/ unlocking mechanism of the billboard panel

3 Conduct a thorough comparative study between the standard and improvised anemometer during calibration.

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