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A FIRST YEAR DESIGN PROJECT

Catolin, Mae
Vallejo, Alvin Antonio
Zapanta, John Elgin
Caballero, Akim Obed

Abstract: ***Noise in educational institutions has always been a problem. This is due to the number of students suing the corridors and classrooms. In spite of this problem being present, no research work has been undertake to determine it extent. This project therefore was undertaken to determine the noise level along the corridors of the College of Engineering building. The results of the noise level varied from a level of 65 decibels to 85 decibels. The standard noise allowed is 70 decibels which showed that the noise level in corridors far exceeded the allowable level. The study therefore recommends that the noise level along the corridors has to be reduced so that it will not create hearing damages to the students and teachers in the future.***

❑ INTRODUCTION

NOISE POLLUTION

Cars, trucks, lawn mowers, leak blowers, chain saws, power drill, television, radio, video games, computers, the list of noise makers in our modern is almost endless, and our world keeps getting noisier. Noise - which can be defined as any unwanted sound - is one of the most common forms of pollution, one that can easily damage the hearing and general health of the people and animals.

We need to study noise so that we could understand or know the effect of it on our hearing. In our study of noise along the Engineering corridor is not enough to determine the sound level.

But the effect of it causes such signs of stress, and according to the experts, noise can also make people irritable and confused. Because when we are exposed to loud noise, our body react as if we must flee danger. Our blood vessels narrow, our skin pales, our muscle tense - all evidence that our body senses danger.

We also damage our ears if we are expose to noises that are less loud, but that we hear more often. For example, office workers who daily endure noise from telephones and loud machines may lose some hearing over time. Workers in loud factories also experience hearing lose.

Noise pollution can also affect animals. For example, sudden loud noises can wake animals that are hibernating. This, in turn, raises their metabolic rates and can cause them to consume fats reserves they need to survive through to spring. And also, it may annoy or disturbed classes, it can interfere with the ability of person to converse with someone else.

❑ HISTORICAL DEVELOPMENT OF SOUND

The data given in the table that follows is for Single Event Noise levels (SENL), the loudness of the noise that interrupt sleep, conversation, TV watching and disrupts classroom activities.

Most published information from the country, regarding noise for the El Toro reuse project. Is given in a very different measure: as Community noise Equivalent levels (CNEL). The CNEL is calculated average over 24-hour period. Because it is a calculation, based on the mixture of noises, it is not possible to hear what 65 CNEL sounds like.

The brief but loud sound of a jet plane flying near to engineering building which can exceed 10db SENL, is averaged with the longer intervening quiet period, which may be 45db SENL, when calculating the CNEL. A deafening explosion, on an otherwise quiet day, similarly might yield a low CNEL calculation. Night time noises are "penalized" by 5 or 10 dB in the CNEL calculations.

The country of Orange Environmental Impact Report takes the position that a 65 dB CNEL does not impose a significant adverse impact, even though it may include repeated short bursts of very loud noise.

❑ Sound levels (dB) and relative loudness of typical noise sources in indoor and outdoor environments.

DB (A)	Overall Level	Community Voice Levels (Outdoors)	Home and Industry Noise Levels	Subjective Loudness (Relative to 70dB)
120	Uncomfortably loud	Militaryjet aircraft take-off from aircraft carrier with afterburner at 50 ft. 130dB	Oxygen Torch. 121dB	32 times as loud
110		Turbo-fan aircraft at take-off power at 200 ft 118dB	Reverting machine. 110dB Rock band. 108-114 dB	16 times as loud
100		Boeing 707 or DC-8 aircraft at one nautical mile (6080 ft.) before landing... 106dB jet fly-over at 1000 ft. 103dB Bell J-2A helicopter at 100 ft. 100dB	Newspaper Press 97dB	8 times as loud
90		Boeing 737 or DC-9 aircraft at one nautical mile (6080 ft.) before landing... 97dB Power mower...96dB Motorcycle at 25 ft. 90dB	Newspaper Press ...97dB	4 times as loud

80		Car washes at 20 ft. 89dB Propeller plane Fly-over at 1000 ft. 88dB Diesel truck 40mph at 50 ft. 84dB Diesel train 45 mph at 100 ft. 83dB	Food blender...88dB	2 times as loud
70		High urban ambient sound...80dB Passenger car 65 mph at 25 ft. 77dB Freeway at	Living room music...76dB Radio or TV-audio vacuum cleaner...70dB	70dB (A)
60		Air conditioning unit at 100 ft. 60dB	Cash registrar at 10 ft. 65-70dB Electric typewriter at 10 ft. 64dB Dishwasher (Rinse) at 10 ft. 60dB Conversation ...60dB	1\2 as loud
50		Quiet Large transformers at 100 ft. 50dB		1/4 as loud
40		Birds calls...44dB Lowest limit urban ambient sound...40dB		
10		Just audible		
0		Threshold of hearing		

3.1 PROBLEM DEFINITION

To determine the noise level along the corridor of engineering building. This is a critical problem during class hour's break. Noise cannot be avoided, but later on, this study can give the possible recommendation to reduce the impact of the intensity of sound. Noise is a mixture of many different frequency or notes not harmonically related. It is an effect creating a sound. Many students especially during the class interval/ after the first bell. Walk along the corridor and create a noise problem.

3.2 ULTIMATE OBJECTIVE

a) To measure the sound level at the corridor and stairways during the interval/ after the first bell.
b) Get the necessary data to determine the value of sound level.
c) To recommend methods that can be used to lower the noise level along the corridor.

3.3 IMMEDIATE OBJECTIVES

a) To determine the sound level of corridor and stairway during class interval or after the first bell.
b) To find possible solution of noise solution on Engineering corridor.
c) Determine or find the effect of noise on human health based on past record.

3.4 LIMITATION OF STUDY

The study will be made on Thursday at 8:25-8:30 until 5:30 in the afternoon and at Friday 7:55-8:00 until 4:55-5:00. Only two days of collecting the sound level at the corridor. Collection of data limited only at the corridor of Engineering building at Central Philippine University.

❑ METHODOLOGY:

1. First, measure the sound level in the stairway or the third floor and record data.

2. Then stairway of second floor.
3. And also stairway of third floor.

4. Determine the value of sound level and effect on the human being.

5. Gathering information form the following members of the group to analyze the topic.

4.1 DATA COLLECTION AND ANALYSIS

Measure the sound level of third floor, stairs at second floor and first floor at Thursday starts at 8:25-8:30 to 5:25-5:30 until Friday starts at 7:55-8:00 to 4:55-5:00 in the afternoon. All gathered information will be treated as a whole so that each member can deliver idea as an effect of study.

In this study as we gathered data, sound could either be at the highest range and sometimes it could either be in normal. Because the data we have collect, reached at 70 dB but sometimes it can reached more than 85 dB, and may be it can damage cars gradually according to the report we have read.

Day	Time	Data collection of noise level at corridor		
		1st floor	2nd floor	3rd floor
Thursday	8:25	82 dB	80 dB	74 dB
	8:30	84 dB	82 dB	70 dB
	9.55	83 dB	84 dB	70 dB
	10:00	84 dB	84 dB	72 dB
	11:25	74 dB	70 dB	61 dB
	11:30	70 dB	82 dB	60 dB
	12:55	61 dB	60 dB	60 dB
	1:00	64 dB	62 dB	64 dB
	2:25	74 dB	72 dB	74 dB
	2:30	74 dB	74 dB	85 dB
	3:55	72 dB	70 dB	80 dB
	4:00	73 dB	72 dB	84 dB
	5:25	72 dB	74 dB	80 dB
	5:30	72 dB	74 dB	85 dB
Friday	7:55	72 dB	70 dB	60 dB
	8:00	82 dB	64 dB	64 dB
	8:55	80 dB	74 dB	64 dB
	9:00	80 dB	80 dB	64 dB
	9:55	74 dB	74 dB	72 dB
	10:00	80 dB	70 dB	72 dB
	10:55	70 dB	60 dB	64 dB
	11:00	64 dB	60 dB	72 dB
	11:55	70 dB	60 dB	72 dB
	12:00	60 dB	62 dB	64 dB
	12:55	61 dB	72 dB	74 dB
	1:00	64 dB	74 dB	72 dB
	1:55	70 dB	74 dB	72 dB
	2:00	74 dB	74 dB	74 dB
	2:55	72 dB	72 dB	60 dB
	3:00	74 dB	70 dB	74 dB
	3:55	72 dB	74 dB	64 dB
	4:00	70 dB	72 dB	74 dB
	4:55	60 dB	70 dB	62 dB
	5:00	61 dB	64 dB	71 dB

4.2 Resources and Facilities

Resources needed are the Realistic Sound Level Meter. It is an extremely versatile device for measuring sound intensify in just about any acoustic environment and also student creating the noise.

■ WORK SHEDULE:

January 21, 1999 measuring sound level based on the school time

	Meet the group Advisor and discuss about the topic
January 22, 1999	measuring sound level based on the school time
	Research at the library
	Investigate the problem, know the history
	Consult with the advisor and the final right up
January 23, 1999	finalized the written proposal

■ ANTICIPATED PROBLEMS AND POSSIBLE SOLUTIONS

Since this study is about noise of corridor and stairway from first, second floor the anticipated problems is indefinite collection of data or limited number of days of testing because from January 18, 19, and 20 are schedule of midterm exam.

So, the possible solution should increase the number of days of testing so that it must be accurate.

■ CONCLUSION

So that, base on the standard value the noise level varies from 61 dB to 85 dB. If the value of 85 dB is used as the standard results 3 times as loud as the normal standard. Although the maximum value of 60 dB is 1/2 as loud as the normal standard.

Therefore, the recommended that the noise level above 70 dB be reduce to the normal standard. So that, along the corridor will not disturb/distract on going classes. Posting notices for students not to be noisy walking along the corridor can do this. The teachers also stand near the door in order to see to it that the noise level is control. The teachers should advice the students in any class not to be noisy when walking along the corridor.

If this is undertaken, it is expected that the noise level will go down to a maximum 75 dB. This will inturn not cause the destruction and disturbance of classes going on.

The results have showed that by undertaking this study possible solution to the noise problem along the corridor can now be made.

■ References:

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EFFECT OF THE MODIFIED BUS SEGREGATION SCHEME (MBSS) ON BUS OPERATION ALONG THE EPIFANIO DE LOS SANTOS AVENUE (EDSA)

Mr. Alexis M. Fillone

Civil Engineering Department, De La Salle University

Abstract: ***The Modified Bus Segregation Scheme (MBSS) being implemented by the Metro Manila Development Authority (MMDA) to improve bus operations along EDSA was analyzed by taking bus samples before and after its implementation. To determine its effect on bus operations, such bus operating characteristics as travel and stop times, average travel and running speeds, and average passenger-kilometer performance were used as measures.***

Considering the segment of EDSA from Gil Puyat Extension to Aurora Boulevard, the result showed that in general, the average travel and stop time have increased after the implementation of the MBSS, although there was a noted decrease in stop time for a given value of travel time. It was also known that the average passenger-kilometer performance of the buses has not change after the implementation of the MBSS although their average travel and running speeds decreased. Also, no significant differences were noted in the operating performance of the numbered buses, although in the volume survey buses numbered one(1) in operation were quite few compared to buses numbered two(2) and three(3).

1. INTRODUCTION

Public utility buses operating along EDSA are considered one of the main causes of traffic congestion in the area, especially near bus stops. Congestion normally occur when they outmaneuver each other to get passengers thereby blocking adjacent lanes. Bottlenecks and constriction of traffic lanes used by other vehicles result as manifested by long vehicular queues before major bus stops. In addition, the MRT construction which occupies at least two lanes (one in each direction) of EDSA has farther reduced the available number of traffic lanes. For the time being, the lanes occupied by the MRT construction will remain while the project is ongoing. Being a priority project, it is expected that once the MRT system is operational, it will greatly improve commuter travel along EDSA. It is then imperative to introduce traffic management measures on bus operations to alleviate the traffic congestion.

Hence, the introduction of the bus segregation schemes (MBSS) to improve bus operational behavior along EDSA. While there were other traffic management measures introduced before, such as the yellow bus lane and the bus segregation scheme, there has been no schematic evaluation of whether the new scheme is an improvement of the previous scheme. However, going over the details of the new scheme, buses will still be using the segregated yellow lanes while also being allowed to use the under- and over-passes whenever possible and the two grouping of the previous bus segregation scheme have been expanded to three bus groupings. Further each grouping can only stop at 10 of the 22 designated bus stops along EDSA. This latter was done primarily to answer the bus congestion problem near major bus stops. At the very least these are the noted changes in and improvements of the modified bus segregation scheme.

This study aimed to determine the effect of the MBSS on bus operating characteristics along EDSA. Bus samples were taken before the MBSS was introduced in November 12, 1997 and additional samples were again taken after its implementation, since congestion along EDSA is worse during the peak hours (morning and afternoon), bus data were collected during these periods on weekdays. Data were gathered using the classical survey methods such as volume and boarding check surveys.

By concentrating the analysis on the Gil Puyat Extension to Aurora Boulevard segment of EDSA, being the segment used by all buses passing EDSA even though their origin and destination points are different, several interesting results were obtained. For one, the average passenger-kilometer performance of the buses has not changed after the implementation of the MBSS although their average travel and running speeds decreased. Also, significant differences were noted in the operating performance of the numbered buses, although buses numbered one(1) in operation are quite few compared to bus numbers two(2) and three(3).

This study, however limited, has evaluated one of the more economical measures of managing traffic congestion through public transportation system management. It is hoped that the current government should put more emphasis on this approach to solve traffic congestion especially with the limited infrastructure funds available.

2. THEORITICAL CONSIDERATION

Public bus journey time can be divided into three parts, namely: (1) Moving time; (2) traffic delays such as intersection delays; delay due to interaction with other vehicles; delay caused by embarking and disembarking passengers; and other related delays; and (3) turnaround time. Variability on moving time depends largely on the level of service of the road: the more vehicles the more conflict occur, resulting in slower overall speed of the traffic stream. Since city buses operating in Metro Manila have to compete with road space, it is expected that the incidence of traffic delay is high.

Service reliability is a concept frequently applied in measuring bus-operating performance. According to Jordan and Turnquist (1979), it reflects the degree to which buses provide regular or "on-time" service. Along the segment of EDSA, service reliability is quite high; a bus arrives approximately around 7 to 11 seconds in any direction during the peak hour. Hence, the problem of bus service performance lies more on the variability of moving time and actual time spent on bus stops waiting for passengers.

Several public bus transportation system improvement techniques are available to improve bus operation in the urban area (Tanaboriboon 1992). *This in with-flow bus lanes, contra-flow bus lanes, bus-only streets, bus ways, transit priority at traffic signal, bus priority for access to arterials by signal, and preferential treatment of the buses on freeways.* These techniques are currently being applied to improve bus operation. These were the following:

A. the EDSA Bus Lane Scheme (1990) which designated two of the outermost lanes among the six lanes in EDSA as bus lanes on weekdays and yellow lane marking was applied to separate the bus lanes from the ordinary lanes. Initially, the bus lane demarcation was enforced during morning and afternoon peak hours but was later changed to whole day, except on Saturdays, Sundays and holidays. However, confusion prevailed as to how the measure was to be followed and enforced between the drivers and traffic enforcers. The problems encountered included the misconception that the lanes can confine buses within and hence could not use the inner lanes and the rules for right turning vehicles were not clearly defined. Despite these shortcomings, the measure was officially hailed to have improved bus operations along EDSA; and

B. the Bus Stop Segregation Scheme which was intended to make the loading and unloading of passengers at bus stops more organized by dividing the buses plying EDSA into two groups based on their destinations. The bus stop area was delineated at different locations for each group with markings and signs indicating the group number. Buses were required to stop and load/unload passengers only at designated bus stops. The scheme was expected to enhance the convenience of public transportation.

The MBSS is the new version of the bus stop segregation scheme, and it was implemented starting November 12, 1997. Under the scheme, buses plying EDSA were divided into three groups, with each group allowed stop at no more than 10 of the 22 identified bus stop of EDSA from Mantrade to Balintawak. However, a bus may stop at any bus stop outside of the given limits or boundaries. The groups were numbered 1, 2, 3, and assigned with colors Tangerine, Yellow-Gold and Green, respectively. One-foot reflectorized stickers bearing the color-coded numbers, as manufactured and controlled by IMBOA (Integrated Metro Bus Operators Association), are placed at the right windshield to identify the buses. The same color-coded number is painted on the left side of the door. IMBOA is responsible for assigning bus stops and numbers and issuing stickers to buses. Non-IMBOA members have to communicate directly with IMBOA for their bus stops assignments and stickers. Signs were installed (just like the first bus stop segregation scheme) at the different bus stops to indicate which buses stop there and help commuters identify the buses they have to take.

An initial study done by the author, (Fillone, et. al 1998) showed that the average passenger-km performance of air-conditioned buses along the Gil Puyat Extension to Aurora Boulevard segment to EDSA did not change after the implementation although there were some noted decrease when the whole route system is considered. On the other hand, the average travel and running speeds decreased after the implementation although other extraneous factors such as the MRT construction and the pre-Christmas season traffic could have caused it.

With additional independent random sample gathered, bus data have to be tested for normally and variability in order that hypothesis testing regarding the changes in the means of these data after the implementation of the scheme can be performed. The F test, under the single-factor analysis of variance (ANOVA) model, is a preliminary statistic to be used between the alternatives is

$F^* = MSTR/MSE$

where,

MSTR = treatment mean square

$= SSTR/(r-1) = \sum_i ni(Yi.-Y..)^2/(r-1)$

MSE = error mean square

$= SSE/(n_T-r) = \sum \sum (Yij-Y..)^2/(n_T-r)$

$= \sum_i \sum_j e^2 ij/(n_T-r)$

And the appropriate decision rule to control the level of significance at EMBED Equation.α is:

If $F^* \leq F(1-\alpha ; r-1, n_T-r)$, conclude H_o

If $F^* \geq F(1-\alpha ; r-1, n_T-r)$, conclude H_a

where,

$F(1-\alpha ; r-1; n_T-r)$ is the $(1-\alpha)100$ percentile of the appropriate F distribution.

A detailed analysis was undertaken to determine if the F test leads to the conclusion that the factor level means μi differ. These detailed analysis include:

A. Estimation of a factor level mean .μi

The confidence limits for μi with confidence coefficient

$1 - \alpha$ are:

$\overline{Y} \pm t(1-\alpha/2; n_T - r)s\{\overline{Yi}\}$

where

$t(1 - \alpha/2; n_T - r)$ the two sided t-

distribution
$s\{\bar{Y}_{i.}\}$ is the estimated standard deviation of the sampling distribution of $\bar{Y}$ (sample mean)

B. Turkey method multiple comparisons of factor level means

The Turkey method of multiple comparisons considers the set of all pairwise comparisons of factor level means which consists of estimates of all pairs $D = \mu_i - \mu_{i'}$. The family confidence coefficient of at least $1-\alpha$ are as follows:

$$\bar{D} \pm Ts\{\bar{D}\}$$

where,

$$\bar{D}=\bar{Y}_{i.}-\bar{Y}_{i.}$$

$$s^2\{\bar{D}\}=s^2\{\bar{Y}_i\}+s^2(\bar{Y}_{1.})=MSE\{^1/_{ni}+^1/_{n}\}$$

$$T=(^1/_{\sqrt{2}})q(1-a;r;n_T-r)$$

When the distribution of the data depart from normality. The Kruskal-Wallis Rank Test can be used to test the whether the treatment means are equal. The test statistics of the Kruskal-Wallis Rank Test, X^2_{KW}, expressed as

$$X^2_{KW} = [(^{12}/n_T(n_T-1))\sum_{i=1}^{r} n_i R^2_{i.}]-3(n_T+1)$$

With n_i reasonably large (5 or more), X^2_{KW} is approximately a X^2 random variable with r-1 degrees of freedom and having the following hypothesis test:

$H_0:\mu_1=\mu_2=....=\mu_r$
H_a:not all μ_i are equal

The appropriate decision rule for controlling the risk of making a Type I error at $\underline{\ \alpha\ }$ is:

If $X^2_{KW} \leq X^2(1-\alpha;r-1)$, conclude H_0
If $X^2_{KW} \geq X^2(1-\alpha;r-1)$, conclude H_a

3. METHODOLOGY

Since the primary objective of this study is to determine the effect of the MBSS on the operating characteristics, bus data were collected before and after the implementation of the scheme.

The primary bus data collection employed in this study are the following:

The boarding checks study. Most bus data were gathered using this data collection method. The data collector rode the bus being observed from the start of the route up to the end of its journey and collected the necessary data along the way. Giannopoulos (1989) discussed this method of determining the number of passengers inside the bus at various points of the route and also to determine passenger boarding and alighting.

To maintain the randomness of data, after identifying the bus service route to be surveyed at the beginning of the journey, the first bus to go was chosen as the sample. If possible, the surveyor should be the first passenger of the bus. Important data were listed down such as route serviced by the bus, time of start, seating capacity of the bus, and date of survey. As the bus stops to pick up and/or drop off passengers, the exact moment the bus stops and the time it moves afterwards were noted down to determine the time of passenger boarding and alighting. Other reasons for stopping such as obstruction caused by other vehicles and intersection delay were also noted down. At the end of the journey, the surveyor made it a point to be the last or part of the last group of passengers to disembark. The exact time the journey ended was then noted down. The last step was to subtract bus seat capacity by one (two) as this was occupied by the surveyor (two surveyors), usually the seat near the door.

This study was performed during the whole year of 1997 and up to June 1998. MBSS data were obtained after the scheme was implemented starting November 12, 1997.

Bus speed and delay studies. Data needed for computation of bus speed and delay were easily obtained by the surveyor by taking note of the time when the bus passes important road junctions or landmarks as well as the causes and duration of delays along the route. Distances were later obtained from a scaled map. Other important observations regarding bus interaction with other vehicles on the road as well as ongoing activities and land use along the route were also listed down.

Bus volume study. The primary purpose of this study is to determine the volume of buses passing through EDSA. The bus volume survey was conducted from 0630 to 0900 HRS in the morning and another one from 1630 to 1930 HRS in the evening. Three bus volume surveys were conducted during these periods: one in August 1997, November 1997, and in April 1998. Fifteen-minute intervals were used in determining the peak hour factor.

After processing the data collected, several bus service operating characteristics were obtained:

A. Average travel speed. Average travel speed is equal to the distance of the segment being studied divided by the total travel time (includes stop time and running time) expended on the segment.
B. Average running speed. Average running speed is equal to the distance of the segment being studied divided by the running time (or moving time) of the segment; and
C. Passenger-kilometer performance. All data regarding the computation of passenger-kilometer performance of buses were obtained with the surveyor on the bus. The computation process was as follows:

    (a) For the route segment of the study, every stop- and move-time of the bus was known. Since the distance of the segment was given, the average running speed could easily be computed as the distance of the segment divided by total running time within the segment.
    (b) Knowing the number of passengers inside the bus at all times, the passenger-

kilometer performance of the bus every time the bus moves along the segment can be easily obtained as follows

No. of Pax-Km = No. of passen gers inside the bus
x the average running speed
x the running time

The average running speed for the whole segment was used since only the distance of the segment was known and it was quite difficult to obtain the bus location every time the bus stopped and moved along the segment for a detailed passenger-kilometer computation.

Statistical techniques were then used to analyze the data as discussed in the previous section to arrive on a set of conclusions.

4. PUBLIC BUS TRANSPORT ALONG EDSA

Metro Manila's PUBs. The public utility buses of Metro Manila are mostly imported. The buses are usually single-door types for air-conditioned unit and two-door types for non-air-conditioned units. The seating capacity of these buses range from 46 to 66, were the seats are usually arranged in fours or fives in a row, two-by-two or two-by-three facing the direction of motion. There are some modifications, however, like the removal of some of the seats near the door to improve movement of embarking and disembarking passengers, or to provide space for standing passengers. Bus fares are collected by a conductor/ conductress inside the bus.

Bus routes. The major street network of Metro Manila consists mostly radial and circumferential routes. The radial routes radiate from the city of Manila toward other urban and suburban areas while circumferential routes traverse these radial routes.Urban centers that attract most daily urban trips are the Ayala and Ortigas business districts. Figure 1 also shows the extent of bus route being studied with EDSA as the major segment of these route.

Urban bus service. Urban service in Metro Manila can be considered as local bus service since all stops along a route are being served. Along EDSA, buses stops on all bus stops and even on locations not designated as bus stops, although MBSS has modified this to some extent. With MBSS, the numbered buses can only stop in 10 of the 22 designated bus stops along EDSA. However, as observed, buses were still able to stop at any point along the route either to drop off or to pick up passengers especially when there were no traffic enforcers around.
Major bus stops along EDSA are either situated on the near side or far side of an intersection or at locations where there are major activity centers like shopping malls. Bus stops are also located near pedestrian overpasses for the convenience of the commuters. All bus stops are adjacent to the curb for direct and easy access by passengers.

Bus volume study. The ongoing Metro Manila Urban Transportation

Integration Study (MMUTIS 1996-1998) mentioned that the peak period in the morning occurs from 0700 to 1000 HRS, while the evening peak period occurs from 1600 to 1900 HRS. Three bus volume surveys were conducted during these periods: one in August 1997, November 1997, and in April 1998. Table 1 shows the average results of the first two surveys while Table 2 shows the bus volume survey in April 1998 with bus numbering fully in place. The peak hour volume has observed to occur within the specified peak periods. Not much different in bus traffic volume during the peak hour transpired after the implementation of the MBSS scheme. The data showed that

- The proportion of buses in the north-bound and south-bound directions has a difference of no more than 10 percent, with higher south-bound traffic during the morning peak hour and higher north-bound traffic in the afternoon peak hour
- The ratio of non-air-conditioned buses to air-conditioned buses is around 1:3
- The proportion of number 1 buses is quite low (9 to 10 percent) compared to numbers 2 and 3 buses (40 to 48 percent) of the total buses flow during the estimated peak hour
- With MBSS fully in place, the volume survey in April 1998 showed that around 1 to 2 percent of buses travelling during the peak hour did not have numbers; roughly the same proportion had signs too inconspicuous to be seen.

Table 1. Public bus transit volume survey

Morning Peak Hour	Air-conditioned		Non-airconditioned		Total	
	No. of Buses	%	No. of Buses	%	No. of Buses	%
North-bound	229	28.84	138	17.38	367	46.22
South-bound	296	37.28	131	16.50	427	53.78
Total	525	66.12	269	33.88	794	100
Afternoon Peak Hour	**Air-conditioned**		**Non-air-conditioned**		**Total**	
	No. of Buses	% No. of	Buses %	No. of	Buses	%
North-bound	228	32.66	117	16.76	345	49.43
South-bound	235	33.67	118	16.91	353	50.57
Total	463	66.33	235	33.67	698	100

Table 2. Public bus transit volume survey (April 1998)

Morning Peak Hour		North-bound		South-bound		Total	
		Frequency	%	Frequency	%	Frequency	%
Aircon	Bus#1	27	2.77	35	3.59	62	6.37
	Bus#2	108	11.09	117	12.01	225	23.10
	Bus#3	150	15.40	177	18.17	327	33.57
	None	3	0.31	4	0.41	7	0.72
Total		288	29.57	333	34.19	621	63.76
Non-aircon	Bus#1	26	2.67	21	2.16	47	4.83
	Bus#2	82	8.42	80	8.21	162	16.63
	Bus#3	64	6.57	76	7.80	140	14.37
	None	2	0.21	2	0.21	4	0.41
Total		174	17.86	179	18.38	353	36.24
Grand Total		462	47.43	512	52.57	974	100.00
Afternoon Peak Hour		**North-bound**		**South-bound**		**Total**	
		Frequency	%	Frequency	%	Frequency	%
Aircon	Bus#1	27	3.59	12	1.60	39	5.19
	Bus#2	124	16.49	102	13.56	226	30.05
	Bus#3	123	16.36	111	14.76	234	31.12
	None	1	0.13	6	0.80	7	0.93
Total		275	36.57	231	30.72	506	67.29
Non-aircon	Bus#1	16	2.13	14	1.86	30	3.99
	Bus#2	64	8.51	55	7.31	119	15.82
	Bus#3	53	7.05	38	5.05	91	12.10
	None	5	0.66	1	0.13	6	0.80
Total		138	18.35	108	14.36	246	32.71
Grand Total		413	54.92	339	45.08	752	100.00

5. BUS OPERATING CHARACTERISTICS FOR ANALYSIS OF THE MBSS EFFECT

The bus operating characteristics that were analyzed to measure the MBSS effect include travel and stop times, average travel and running speeds, and average passenger-kilometer performance.

Travel and stop times can provide facts about the effect of reduced number of stops on bus travel. Average travel and running speeds can provide information whether improvements in bus travel have resulted, while average passenger-kilometer performance can give insights into the revenue performance effect of the MBSS implementation on bus operators. The study gave emphasis on Gil Puyat Extension to Aurora Boulevard segment of EDSA. This segment is part of the routes being serviced by all buses passing EDSA regardless of their destination within Metro Manila.

Bus Travel Time and Delay. Table 3 shows the average travel (stop plus moving time) and stop time of air-conditioned buses before and after the implementation of the MBSS along the Gil Puyat Extension to Aurora Boulevard segment of EDSA. **Figure** 2 shows the scatterplots of the travel time versus stop time. The following observations can be derived from the presentations:

A. In general, the average travel has became longer after the implementation of the MBSS by around 0.223 hr. (13.38 minutes) while average stop time increased by only around 0.07 hr (4.26 minutes).

B. The relationship between the travel and the stop times of buses as represented by the trendlines, has shifted upward after the implementation of the MBSS. The shift tells us that considering the same duration of time travel along the segment, travel time was equal to one hour before MBSS, while stop time was around 0.444 hr. (27 minutes). After MBSS, it was only around 0.344 hr. (21 minutes), or a savings of six minutes on a one-hour total travel time. This observation could be the result of reducing the number of major bus stops a bus can stop along the segment under MBSS.

Table 3. Average travel and stop times of air-conditioned buses

	Average Stop Time Hour (minutes)	Average Travel Time Hour (minute)
Before MBSS	0.291(17.46)	0.802(48.12)
After MBSS	0.361(21.66)	1.025(61.50

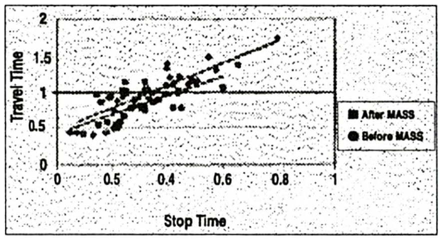

Figure 2. Stop versus travel time of air-conditioned buses along a segment of EDSA

Since in totality the average travel time and stop times have increased, MBSS was hardly a factor in improving air-conditioned bus movement along EDSA. However, the data showed that this scheme reduced average stop time by a few minutes per average total travel time.

ANOVA Model I was used to test the other operating characteristics. Using this method, the before-and-after MBSS situations as well as the bus numbering system were considered as factor levels and have probability distribution of responses (the independent variables). These responses are assumed normal and of the same variance (standard deviation) and observations are randomly obtained and are independent from observations of other factor levels. Hence, to start the analysis, the response variables such as the average travel and running speeds and the average passenger-kilometer performance of buses were tested concerning their probability distributions.

5.1 Test on the Distribution of Data

Table 4 shows the data regarding the average travel and running speeds and average passenger-kilometer performance of the 60 air-conditioned buses, 30 before and 30 after the implementation of the MBSS, surveyed. There are several available tests to determine whether the sample data came from a normal population. One of these is the normal probability plot wherein the actual residuals of the variable are plotted against its expected residuals. If the plot appears straight along the diagonal, the data can be considered as normal. **Figure 3** shows one of these plots using the residuals and expected residuals of the average passenger-kilometer of the air-conditioned buses sampled after implementation of the MBSS. To strengthen this normality proof further, the correlation between the actual residuals and the expected residuals were compared to a set of correlation values under normality as prepared by Looney and Gulledge, Jr. (1985). **Table 5** shows these correlation values of all variables studied were only the average running speed (before MBSS) and the average passenger-kilometer (after MBSS) of the buses passed the critical values. The average passenger-kilometer (before MBSS) was quite near the critical value and the rest of the variables were quite far off. Hence, the average passenger-kilometer for both cases (before and after) tend to behave normally.

Except for the average running speed (before MBSS), the other distribution of the average travel and running speeds were not near normal. Hence, the average and running speeds was not further analyzed with regard to their variability because they seemed have failed one major criteria for normality.

Table 4. Average travel and running speeds and average passenger-kilometer performance of air-conditioned buses

Before MBSS			After MBSS			
Average Travel Speed (kph)	Average Running Speed (kph)	Average Passenger-Km Performance	Bus No.	Average Travel Speed (kph)	Average Running Speed (kph)	Average Passenger-Km Performance (Pax-Km)
9.38	14.66	344.72	3	9.09	12.02	306.53
8.89	13.95	492.04	2	19.09	28.40	342.28
9.13	11.22	482.89	1	10.08	16.89	315.42
10.12	16.63	608.99	1	8.46	11.45	459.64
14.11	20.52	291.24	1	7.55	9.84	178.82
8.86	13.58	353.86	3	5.97	8.89	504.09
10.48	18.33	360.50	2	6.52	9.90	364.22
14.2	23.25	276.92	1	10.05	24.02	336.32
17.92	30.24	277.63	1	5.29	8.45	302.49
10.07	21.87	407.04	3	7.78	11.17	341.00
11.67	18.37	459.02	1	8.45	12.47	456.84
14.30	19.52	503.21	3	6.53	10.36	453.77
9.55	15.81	276.14	3	14.86	27.13	231.72
15.92	27.59	273.58	1	8.41	10.68	136.23
8.82	15.12	350.95	2	9.68	14.75	456.49
7.43	17.17	404.12	3	6.71	11.51	408.23
17.91	22.88	438.32	2	5.70	10.92	205.56
18.56	20.90	316.84	2	6.00	10.79	301.86
7.14	9.95	407.15	2	7.10	12.36	346.68
8.61	12.48	258.15	1	8.14	10.90	205.91
7.89	14.10	367.27	1	4.53	8.36	612.35
6.76	11.98	288.86	3	17.38	20.80	237.75
8.87	11.15	482.63	3	6.95	12.50	274.02
9.63	15.74	140.48	3	10.68	14.87	570.06
8.05	13.45	188.46	3	8.34	12.94	363.94
7.15	11.64	277.24	2	5.60	7.85	404.04

7.20	19.78	871.93	2	6.90	8.82	256.69
10.19	15.56	74.04	2	7.02	11.34	287.95
8.20	9.62	676.42	2	7.80	11.43	246.99
9.72	15.54	441.50	1	8.59	13.53	400.90

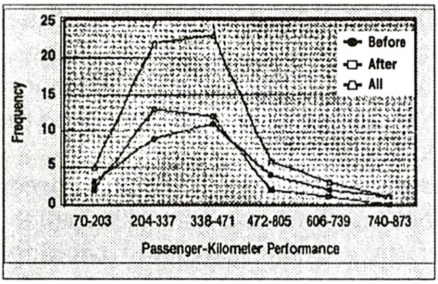

Figure 3. Plot of residuals vs. expected residuals of the average passenger-kilometer performance of air-conditioned buses after MBSS

Table 5. Test for normality using the coefficient of correlation of air-conditioned buses operating characteristics.

	Operating Characteristics	Coefficient of correction	Critical values (α=0.05)	No. of Samples	Remarks
Before MBSS	Ave. Pax-Km	.955	.964	30	Fail
	Ave. Trvl. Speed	.918	.964	30	Fail
	Ave. Run. Speed	.970	.964	30	Pass
After MBSS	Ave. Pax-Km	.989	.964	30	Pass
	Ave. Trvl. Speed	.878	.964	30	Fail
	Ave. Run. Speed	.890	.964	30	Fail

Table 6. F-Test for variances of the average passenger-kilometer performance of air-conditioned buses before and after the implementation of the MBSS

	Before MBSS	*After MBSS*
Mean	379.738	343.626333
Variance	25048.4937	12923.3268
Observations	30	30
Df	29	29
F*	1.93823882	
P(F≥f) one tail	0.0399722	
F Critical one-tail	1.86081195	

The variances of the average passenger-kilometer were tested using the F-Test for equality of variance. Table 6 shows F*>$_{critical,}$ therefore the variances of the average passenger-km performance of air-conditioned buses before and after the implementation of the MBSS somewhat differed. However, the value of F* is quite near the F $_{critical}$ which tells us that the variability was not that large. As Figure 4 would show, their frequency polygons were almost similar in shape with only some shifts near the center.

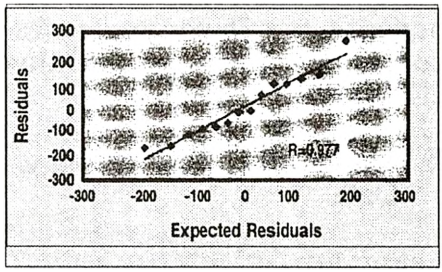

Figure 4 Frequency polygon of the average passenger-kilometer performance of air-conditioned buses

Similarly, for non-air-conditioned buses, the variables being studied are shown in Table 7 below. Again, the results in Table 8 show that the average passenger-kilometer garnered behave normally. Figure 5 presents the normal probability plot of the actual residuals versus the expected residuals of the average passenger-kilometer of non-air-conditioned buses sampled before the implementation of the MBSS.

Table 7. The average travel and running speeds and average passenger-kilometer performance of non-air-conditioned buses

Before MBSS			After MBSS		
Average Travel Speed (kph)	Average Running Speed (kph)	Average Passenger-Km Performance (Pax-Km)	Travel Speed (kph) Average	Running Speed (kph) Average	Passenger-Km Performance (Pax-Km) Average
16.34	25.99	509.41	9.46	13.69	344.767
14.11	20.44	352.41	14.83	19.90	319.514
15.62	23.94	262.00	10.73	15.65	299.903
23.58	28.19	682.23	18.95	27.41	634.668
15.77	23.54	549.95	12.44	29.03	705.711
9.87	11.99	331.57	13.22	18.21	463.765
9.94	12.74	247.43	12.65	17.86	452.464
9.94	11.95	378.83	9.67	13.64	263.728
6.44	10.98	261.80	9.66	13.47	276.221

8.42	12.89	400.21	10.76	14.77	841.648
8.57	11.88	587.88	10.75	15.16	845.577
8.57	13.64	496.28	10.61	13.84	327.319
8.32	11.59	305.66	10.74	14.87	314.780
10.40	15.26	507.91	10.76	14.57	835.068

Table 8. Test for normality using the coefficient of correlation of non-air-conditioned characteristics

	Operating Characteristics	Coefficient of correlation	Critical values (α=0.05)	No. of Samples	Remarks
Before MBSS	Ave. Pax-Km	.977	.935	14	Pass
	Ave. Trvl. Speed	.916	.935	14	Fail
	Ave. Run. Speed	.913	.935	14	Fail
After MBSS	Ave. Pax-Km	.936	.935	14	Pass
	Ave. Trvl. Speed	.871	.935	14	Fail
	Ave. Run. Speed	.857	.935	14	Fail

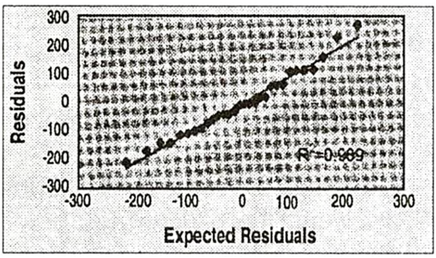

Figure 5. Normal probability plot of expected residuals vs. actual residuals of the average passenger-kilometer performance of non-air-conditioned buses before MBSS

In **Table 9** below, at α = .05, $F^* < F_{critical}$. Therefore the variances of the ave. paxpkm performance of non-air-conditioned buses before and after the implementation of the MBSS did not differ.

Table 9. F-Test for variances of the average passenger-kilometer for non-air-conditioned buses before and after the implementation of the MBSS

	Before MBSS	After MBSS
Mean	409.6711	500.3666
Variance	15396.24	50457.18
Observations	14	14
Df	13	13
F*	0.305135	
P(F≥f) one tail	0.020519	
F Critical one-tail		0.388059

As determined, the sample data of the average pax-kilometer performance were quite normal and equal variability. With bus samples, the confidence interval range can now be obtained for the average pax-km and is shown in **Figure 6.** The confidence interval range for air-conditioned buses shifted a bit downward after the implementation of the MBSS while that for non-air-conditioned buses moved a bit upward The confidence range of the airconditioned buses is quite tight compared to non-air-conditioned buses because there were more samples taken (30 samples for air-conditioned buses, compared to 14 for non-air-conditioned buses for both before and after the MBSS) of the former.

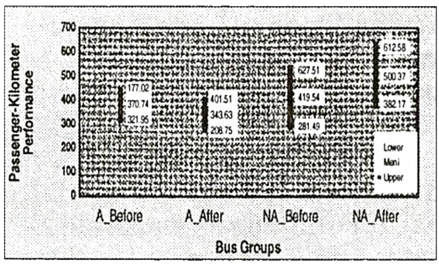

Figure 6. Estimated confidence interval (α=.05) of the average passenger-kilometer perfomance of air-conditioned and non-air-conditioned buses before and after the implementation of the MBSS

A statistical tests showed, the average travel and running speeds of buses did not behave normally, hence we cannot assume that the distribution of these variables are normally distributed. Just to give some insights into the effect of the MBSS on these variables, the sample means of the average travel and running speeds for all bus types are given in the Table 10.

Table 10. Average travel and running speeds of buses before and after the implementation of the MBSS

Bus Type	No. of Sample	Before MBSS		After MBSS	
		Mean of Ave. Travel Speeds (kph)	Mean of Ave. Running Speeds	Mean of Ave. Travel Speeds (kph)	Mean of Ave. Running Speeds (kph)
Aircon	30	10.56	16.75	8.51	13.41
Non-aircon	14.	11.85	16.35	11.80	17.29

Through the average travel and running speeds were non-normal there are other non-parametric statistical tools available to determine the change in means of the sample such as the Kruskal - Wallis rank test.Applying Kruskal Wallis rank test to determined whether change in average travel and running speed occurred after the application of the MBSS for both air-conditioned and non-air-conditioned buses, **Table 11** gives the result. As shown, the average travel and running speeds of air-conditioned buses decreased after the application of the MBSS while that for the non-air-conditioned buses remain the same.

Table 11. Kruskal-Wallis Rank Test for changes in the average travel and running speeds

	Speed	Before R_1	After R_2	X^2_{KW}	$X^2_{critical}$	Remarks
Aircon	Ave. Travel Speed	37.567	23.433	9.824	3.841	$X^2_{KW} > X^2_{critical}$ Accept Ha
	Ave. Running Speed	37.533	23.467	9.731	3.841	$X^2_{KW} > X^2_{critical}$ Accept Ha
Non-aircon					3.841	$X^2_{KW} < X^2_{critical}$ Accept Ho
					3.841	$X^2_{KW} < X^2_{critical}$ Accept Ho

5.2 ANOVA MODEL I to Test the average Pax-Km Performance of the buses

Using ANOVA MODEL I, two tests were undertaken on the average passenger-kilometer performance of the buses. These are the following:

1. With two factor levels, (1) before MBSS, and (2) after MBSS, data on the average passenger-kilometers (the response variable) from the two studies were tested if changes occurred. This was done for both air-conditioned and non-air-conditioned buses.
2. With buses under MBSS grouped into three, we think of these groupings as factor levels. The test would like to determine how they have performed and whether anyone among the three groups got worse/ better off from the scheme. This was done only for air-conditioned numbered buses.

Assuming that we to control the risk of making Type I error at $\alpha = .05$, $F_{critical} = 4.007$ Since $F^* < F_{critical}$ we conclude H_0, that the mens of the average passenger -kilometer of air conditioned buses along the segment mentioned did not differ after the implementation of the MBSS.

Using the same test on non-air-conditioned buses, $F^* = 1.323 < F$ critical = 4.2252, we again conclude H_0, that the means were equal or that the means of the average passenger-kilometer performance of non-air-conditioned buses before and after MBSS did not differ.

Table 12. F-Test for variances of the average passenger-kilometer performance of air-conditioned buses

Source of Variation	SS	df	MS	F*	P-value	Fcrit
Between Groups	19560.79	1	19560.78704	1.030279	0.314309	4.006864
Within Groups	1101183	58	18985.91025			
Total	1120744	59				

Under the MBSS scheme, the buses were divided into three groups numbered 1, 2, and 3. It would be interesting to know how each group has been performing under the scheme. However, it was noted down that the assigning of bus numbers to buses were not done proportionately. This was observed from the volume survey in Table 3, where the No.1 buses are few (9-10%), compared to Nos. 2 and 3 (40-48%), of the total buses operating during the peak hour. Nevertheless, the same number of samples, 10 from each group, was taken which in the previous section totaled to 30 samples. Table 13 below shows the average passenger-km performance of the numbered buses under the MBSS. On the other hand, Table 14 shows the coefficient of correlation of the means of the average passenger-kilometer have passed the critical value showing that they tend to be normally distributed. These can be further bolstered by the frequency histogram shown in Figure 7 where the average passenger-kilometer performance of the majority of the samples tend to cluster in the middle.

Table 13. Average passenger-kilometer performance of air-conditioned numbered buses under the MBSS

Samples j	Bus Number, i		
	Bus#1 (kph)	Bus#2 (kph)	Bus#3 (kph)
1	315.42	306.53	342.28
2	459.64	364.22	504.09
3	178.82	456.49	341.00
4	336.32	205.56	453.77
5	302.49	301.86	231.72
6	456.84	346.68	408.23
7	136.23	404.04	237.75
8	205.91	256.69	274.02
9	612.35	246.99	570.06
10	400.90	287.95	363.94
Mean (Y_i)	340.49	317.70	372.69
Mean (Y_i)	343.63 (all samples)		

Table 14. Air-conditioned numbered buses test for normality

	Bus No.	Coefficient of Correlation	Critical value (α=.05)	No. of Samples	Remarks
Ave. Pax-Km	1	0.984	0.918	10	Pass
	2	0.989	0.918	10	Pass
	3	0.984	0.918	10	Pass

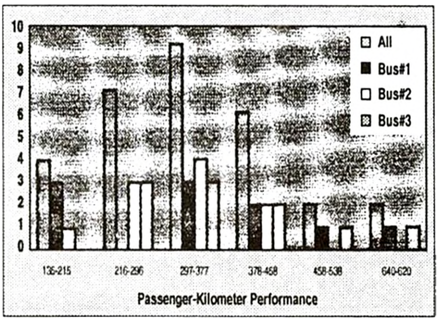

Figure 7. Sample frequency histogram of the average passenger-kilometer of numbered buses

Table 15. Comparison of the average passenger-kilometer variances between the numbered buses

Bus Number	Mean (kph)	Variance	Compared to					
			Bus#1		Bus#2		Bus#3	
			F*	Fcrit	F*	Fcrit	F*	F_{crit}
Bus#1	340.49	21,483.59	****	****	3.698	3.179	1.698	3.179
Bus#2	317.70	5,808.83	3.698	3.179	****	****	0.459	0.315
Bus#3	372.69	12,653.40	1.698	3.179	0.459	0.315	****	****

Table 15 above shows the F-Test for variances of the numbered buses. Only the variances of the buses 1 and 3 did not differ since the comparison passed the critical F-value. The other values being compared have F-values a little over near the F critical though they were expected to pass the critical F -values if only more samples are taken.

It is now desired to determine whether or not the means (μi) of the ave. pax-km of the number of equal. The alternative conclusions considered were : H_0: $\mu_1 = \mu_2 = \mu_3$ and Ha : not all μi are equal Since F·0.4597 <F_{crit}=3.4028, we concluded H_0 that the means of the average pax-km of three bus types are equal. This results tells us that there was no relation existing between the numbering of the buses and thier corresponding average passenger-kilometer performance.

Table 16. The result of the ANOVA for the three bus types

Source of Variation	SS	df	MS	F*	P-value	Fcrit
Between Groups	13576.6	2	6788.302	0.459718	0.636907	3.402832
Within Groups	354389.3	24	14766.22			
Total	367965.9	26				

Since it has been proven using the F-test that no relation exist between the levels (the numbering of buses) and the dependent variable (the ave. pax-km performance), detailed analysis of the factor level effects may not be necessary. However, additional analysis will be undertaken to show additional proof of what has just been proven. Further analysis include, (1) Normal probability plot of estimated means of the average pax-km of the numbered buses, and (2) The Tukey method of multiple comparison of the ave. pax-km means of the numbered buses (factor levels).

Normal Probability Plot of Estimated Factor Level Means. Since all sample sizes are equal (n_i=10), the normal probability plot can be used to determined factor level means. The expected value of the *i*th ordered estimate factor level means, if all factor level means μ_i were equal, is approximate as (See Neter, Wasserman,and Kutner, 1990:) Expected value =Y + z[(i - .375)/ (r .25) X Sqrt (MSE/N), where the square root term is the estimate standard deviation of Yi., i=1,2 and 3.

The estimated factor level means $\overline{Yi}$ is plotted against the normal percentiles. A linear pattern of the points was obtained since the expected values are a linear function of the percentiles. The expected values were also plotted to serve as a reference line whether how far the estimated mean $\overline{Yi}$ deviate from its expected value. The plots of the data are shown in Figure 8 below.

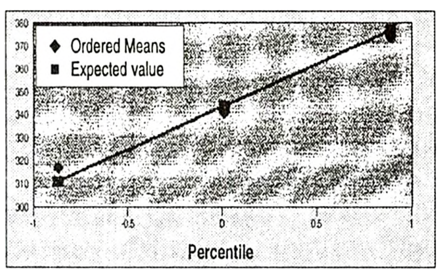

Figure 8. Normal probability plot of estimated means of passenger-kilometer performance of the three bus types

The fact that the points of the means of the ave. pax-km performance of the three numbered buses were close to the reference line (expected value), these suggest that all means μ_1 are reasonably equal In other words, result supported the F-Test conducted previously.

Multiple Comparison of factor level means (Turkey Method). To stimate all pairwise comparisons by means of the turkey procedure, a family confidence coeficient of 95 percent was used. From data, r = 3 and $(n_T - r) = 27$ which could give us the required percentile of the studentized range distribution q (.95;3,27) = 3.51. other necessary data were obtained as follows:
$T = (1/\sqrt{2})(2.496) = 2.482$ $s^2\{\bar{D}\} = 19060.66(1/9 + 1/9) = 2663.054$, resulting to $s\{D\} = 51.6048$; hence, $Ts\{D\} = 128.08$
The pairwise confidence interval with 95 percent family confidence coeffient therefore are:

$-105.29 = (340.49 - 317.70) - 128.08 \leq \mu_2 - \mu_1 \leq (340.49 - 317.70 + 128.08 = 150.87$

$-73.10 = (372.69 - 317.70) - 128.08 \leq \mu_1 - \mu_1 \leq (372.69 - 317.70) + 128.08 = 183.07$

$-95.89 = (372.69 - 340.49) - 128.08 \leq \mu_1 - \mu_1 \leq (372.69 - 128.08 = 160.28$

The pairwise comparisons indicate that the means of the average passenger-kilometer performance of buses along the segment mentioned did not differ from each other. Since the confidence intervals cover the value zero, all of the differences are statistically insignificant. No numbered bus type has gained singificantly form the bus numbering arrangement. This result against agrees with the earlier findings.

5.3 Kruskal-Wallis Rank Test for Average Travel and Running Speeds

Since it has been shown that the average travel and running speeds depart from normality, a nonparametric test called the Kruskal-Wallis Rank Test was employed to estimate possible changes in the means. The only assumption in the population distribution being studied using the Kruskal-Wallis test is that

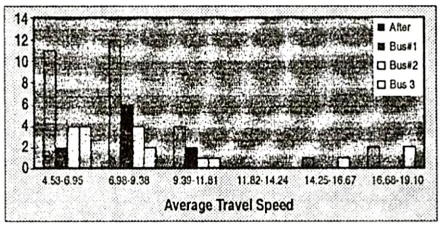

Figure 9. Average travel speed of air-conditioned numbered buses

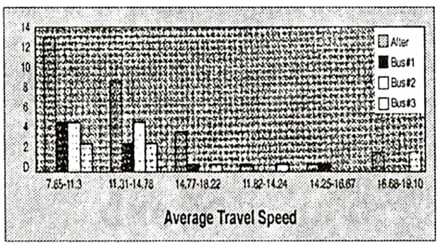

Figure 10. Average running speed of air-conditioned numbered busses

they should be continuous and of the same shape (Neter, et. al., 1990). As Figure 9 and 10 show, the frequency histograms of the average travel and running speeds of the air-conditioned buses are quite similar.
Using the data of Table 17 it can be shown that the B. Kruskal-Wallis test $X^2_{KW} = 3.672$ was lower than the $X^2 0.95,2) = 5.991$, hence we conclude H_0 that the mean of the average running speeds of the numbered buses did not differ. Doing the same process to the average

travel speeds of the numbered buses, X^2_{KW}=2.7587 was lower than the X^2 0.95,2) = 5.991.

Table 17. Average running speed of numbered buses and their Kruskal-Wallis ranks

Bus Sample J (kph) Y_i	Bus Number					
	Bus#1		Bus#2		Bus#3	
	Run. Speed R_i	Rank (kph) Y_i	Run. Speed R_i	Rank (kph) Y_i	Run. Speed R_i	Rank
1	16.89	26	12.02	18	28.4	30
2	11.45	16	9.9	7	8.89	5
3	9.84	6	14.75	24	11.17	13
4	24.02	28	10.92	12	10.36	8
5	8.45	3	10.79	10	27.13	29
6	12.47	20	12.36	19	11.51	17
7	10.68	9	7.85	1	20.8	27
8	10.9	11	8.82	4	12.5	21
9	8.36	2	11.34	14	14.87	25
10	13.53	23	11.43	15	12.94	22
Mean $\bar{R}_i$		14.4		12.4		19.7
Overal rank, R			15.5			

These results showed that non of the numbered buses got a better/worsedeal in their performance since the hypothesis that the means of their average travel and running were the same cannot be disproved.

6. CONCLUSION AND RECOMMENDATIONS

The study aimed to determine the effects of MBSS on bus operating performance along EDSA. Using the bus operating characteristics such as travel and stop times, average travel and running speeds, and average passenger-kilometer performance of buses along the Gil Puyat Extension to Aurora Boulevard segment of EDSA, the following conclusions were derived from the study:

A. In general, the mean of travel and stop times increased after the implementation of the MBSS, although there was a noted decrease in stop time for a given value of travel time may be attributed to the decrease in the number of stops the bus are allowed to stop;

B. One possible reason why average travel and running speeds do not behave normally is that due to MRT and other construction activities, closing of additional lanes sometimes occur in an unpredictable manner thereby causing bottlenecks and reducing average travel and running speeds. This is not true with respect to the average passenger-kilometer performance of the buses, which behaves normally, since daily bus passengers remain the same whether there is congestion or not along EDSA.

C. Using analysis of variance with a confidence level of α = .05, the average passenger-kilometer gained by both the air-conditioned and non-air-conditioned buses did not differ after the implementation of the MBSS. However, this may not be true of the average passenger-kilometer performance of the buses of the entire route they service or on daily basis;

D. Using analysis of variance with a confidence level α = .05, for the air-conditioned numbered buses, no group got better/worse off in terms of the average passenger-kilometer performance. However, as the volume survey would show, there were quite a small percentage of number 1 buses in operation. Since one of the primary purposes of the scheme is the decongest bus stops, equal assignment of buses to each group should be done. In the present situation, if equal proportion of buses is considered, number 1 buses will be disadvantaged. Hence, a reassignment of bus stops to the three bus groups should be looked into before equal proportioning of buses is done.

E. Using Kruskal-Wallis Rank test, the average travel and running speeds of air-conditioned buses decreased after the implementation of the MBSS while that for the non-air-conditioned buses did not differ. Also, for the air-conditioned numbered buses, no differences among the groups were noted in terms of their average travel and running speeds.

This study only considered the effect of the MBSS on bus operating characteristics. However, there are other stakeholders involved whose interests are as important as the buses and bus operators, such as the bus riding public and other vehicles using EDSA. With buses limited to fewer stops than before, waiting time for bus commuters certainly became longer. It would also be interesting to know how traffic flow on the point of view of private vehicles has changed after the MBSS implementation.

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OPEN LABORATORY

Walden S. Rio
College of Engineering
Central Philippine University
Iloilo City 5000 Philippines

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Abstract: ***The education imparted to the student today is based on the lecture being done by the faculty and the laboratory work undertaken by the students with the teacher doing the supervision of the laboratory work. The objective of laboratory work is to bridge the gap between the theory taught in the classroom and the actual practice in the field. At present students are not inclined or motivated to learn from the laboratory work because of lack of space, equipment and competent teacher. The open laboratory concept requires each student to actually perform the laboratory work any time the laboratory is open. In doing this the student will have to learn since they individually have to undertake the laboratory exercise and will be checked by the teacher. The open laboratory may require additional personnel space and equipment but if it will be implemented it will result in students learning more from the laboratory work.***

I. INTRODUCTION

A. EDUCATION

A fundamental question that is always related to education is why do people strive to earn an education? The answer to such a question justifies the need of people to be educated. It goes without saying that people are motivated to learn because they consider the knowledge and know how they may gain to be useful and therefore an asset to possess. The main aim of the teacher, therefore, is to see to it that knowledge is imparted or transferred to the student. It is likewise important that the student does not merely possess the knowledge but must acquire the know how in using that knowledge. Therefore acquiring knowledge is not the end of education, but a means to an end.

There is, however, a paradigm change taking place in higher education. This change states that education is not based on the process (instruction and learning) but is now geared towards the end product or result (learning). The change now taking place transfers the learning process from what was then commonly practiced teacher centered teaching to what is now known as student-centered learning.

In the process of implementing the paradigm change two important concepts have been raised. The first is the need to have all students learn. The second is how will it be done? In the same manner the teacher will have to answer two questions student will always raise whenever they attend classes. The first question is why do they have to learn the subject matter? The second is where will they use the acquired knowledge? If this questions are adequately answered, the students would be motivated to learn and eventually acquire an education they desire.

B. ENGINEERING EDUCATION

We will now go to engineering education. We first define what engineering education is supposed to mean and that is the development of the student to a creative and highly skilled problem-solver. The knowledge they have gained, the skills they have acquired from their education will have turned them into engineers who investigate problems and find solutions to the basic needs of man. Engineers will make scientific discoveries and find ways to harness them for humanity to use. The degree in Engineering that a student earns will open doors to creative and technical challenges for the engineer to face.

Engineering education is usually done in two ways. The first is formal education. There also a growing trend to earn a degree through distance education. The formal Engineering education is usually made up of two parts. The first is the lecture aspect which explains the theories and concepts to the students. Most of the time the teacher does the explaining although the students is the most important component of the process.

The second method of educating engineering students is when they have to take up laboratory subjects. The main purpose of having the students take the laboratory subjects is to bridge the gap between theories taught in the lecture class and the actual practice of engineering in the field.

C. LABORATORY CLASSES

Laboratory classes are usually designed to be three or six-hour classes and are held in either three-hour intervals or, in extraordinary cases, for six straight hours. There are two types of laboratory subjects. The first is the laboratory subject offered as a part or continuation of the lecture subject. In the higher years, however, there are laboratory subjects which are not attached to any lecture classes. It should be mentioned that the methods in the offering of the laboratory subjects are the same and the only difference is the fact that the time placed on the presentation and the course for a lecture with laboratory component has more breadth and depth compared to a pure laboratory subject.

There are several objects in the offering of a laboratory subjects and these are the following:

a. Familiarization with the

use of equipment, supplies, procedures and testing in the laboratory

b. Model identification
c. Validation of assumptions
d. Prediction of the performance of more complex systems
e. Testing and compliance with specifications
f. An explanation of a new and fundamental information

As much as possible, the laboratory should be provided with adequate equipment to serve its purpose. However, this is hardly true of most institutions (due to high cost of equipment), which can barely provide the minimum requirements. There are several ways to maximize the use of available laboratory equipment. One method is to organize students in groups. In the station method, each group is given a complete set of laboratory equipment to do the laboratory exercise. The rotation method allow maximum use of laboratory equipment, especially when these are inadequate. A group will undertake a laboratory exercises with equipment necessary for doing that particular exercise; when the exercise is finished the group will move on to perform another exercise. The rest of the class groups will take their turns in the rotation in doing the various exercises. Some seldom used equipment may be used together by two or more groups but each group must be individually provided with equipment which are constantly used. In large laboratory classes students assist in classes and can greatly lessen the burden of the teacher as to enable him to exercise better control, instruction and coverage.

II. UNDERTAKING LABORATORY CLASSES

A. WHAT IS TO BE DONE

So that the student may learn in a laboratory class, he/she needs to develop several skills. The first skill the student must develop is the ability to understand and undertake how a laboratory exercise is done. The ideal way to develop this skill in a laboratory class is to give the title of the laboratory exercise and leave it up to the student to find out what the procedure in undertaking the laboratory exercise is going to be. The teacher may give hints to help the student obtain the needed information from either the library or any other source. When a student who searched for information, finds what he sought, and understands it such that he/she can apply the information to correctly undertake the required laboratory exercise, the student will have to learned an important skill. It is of utmost importance that all students in the laboratory class should learn how to undertake the laboratory exercises. The next skill needed in a laboratory class is the ability to perform the laboratory exercise independently and individually. When a student does this he/she learns and understand of the subject matter and develops confidence and self-reliance.

The next skill that the student has to develop is understanding the relationship of undertaking the laboratory exercise and how it is related to the practice of the profession of the student after graduation. The fourth skill that needs to be developed by student enriched in a laboratory class is the computational skills. This is done when the student has to actually compute the results independently and individually of each laboratory exercise.

The fifth skill that a student has to develop is communication skills, both written and oral. The results of the student's work in undertaking a laboratory exercise will have to be reported and when the student does this he/she improves his/her writing skills. When the teacher will ask a student to explain how the laboratory exercise was undertaken the oral skills of the student are developed.

The last skill that is needed is discipline in doing the laboratory exercise, preparing the laboratory work and understanding the theory why the laboratory work has to be undertaken. All of these will be attained if the student does his/her work independently. These are the important skills needed to be develop by the student while taking a laboratory subject. In some laboratory subject it can be easily learned while in others it will be a problem but it is important that the teachers should strive to develop these skills in their students.

B. WHAT IS HAPPENNING

A laboratory class will consist of around 30-50 students. In order to perform the laboratory exercises the students are divided into groups. The groups vary in size from 4-12 students. In most cases the size of the groups formed are dependent on the availability of equipment to be used for the specific laboratory exercise. There are cases when the equipment is available but is out of order and cannot be used by the students to perform the laboratory exercise. In most laboratory classes some equipment which are used are not calibrated so that data that are obtained are erroneous.

The laboratory room may not be large enough to accommodate the students in the class so that students who have to perform the laboratory work are not able to do it comfortably. In some cases the supporting facilities such as electrical outlets, gas outlets, water outlets are not available or if it is available it is not adequate. A typical laboratory room will not be able to comply with the CHED requirement of two square meters for each student using the laboratory room.

Most of the time a laboratory class is classified as a secondary class and the teachers who teach the subject are not qualified or have just been recently hired. In such cases students do not learn. The main and foremost problem is that the laboratory teacher is usually paid two-thirds or three-fourths for every hour for undertaking the laboratory class while a teacher is paid full for every hour of undertaking the lecture class.

The typical teacher therefore who is supervising the laboratory class does not understand the theory and the relationship of the subject matter with the lecture or with its importance in the actual practice of the profession.

The students who use this wrong procedure and will do the same thing in the field unless this is rectified within the nearest future.

In a typical laboratory class therefore the teacher is not competent enough to teach the class, the laboratory equipment is not adequate and calibrated. All of these will result in the students not being inspired to learn and what the student will therefore do is just comply with the specific objective of just passing the laboratory subject and then say that a laboratory subject was just a necessary evil for the student to do.

C. PROBLEMS ENCOUNTERED IN LABORATORY CLASSES

Engineering education in the Philippines is beset by lack of laboratory equipment for students to use in doing their laboratory exercises. While this problem may not be much of a bother for small engineering schools, it can be so much worse in schools with large enrolment. There are two possible ways which can solve the problem. The first is the direct way, which is the purchase of as much laboratory equipment, as the school can. This, however, cost money, which most schools can hardly afford to spend. The other way is the use of the open laboratory.

The second problem is doing laboratory exercises in groups of five to six students. The leader performs the laboratory exercise and another acts as a recorder while the rest of the group will just observe how the laboratory exercise is performed. In a group of five students at one or two students will understand how the laboratory exercise was undertaken while the rest will just copy the results of the laboratory exercise often without understanding how it was obtained. This problem might be minimized by the purchase of additional equipment. However, the problem will still be there because it is impossible to have the needed equipment used individually because of time constraints, space limitation and supervision of so many groups undertaking the laboratory exercise. Using the open laboratory concept of doing laboratory work can again solve this problem.

The third problem is that the laboratory procedure for each exercise should be understood by all members of the class but most of the time this is not true. Again the solution to this problem is by using the open laboratory method. The fourth problem is in small colleges of engineering where the enrollment is small the use of the equipment is not maximized. By letting each student undertake the laboratory exercise this problem is answered.

The last and biggest possible problem encountered in most engineering schools is students have to be spoonfed in order for them to learn something. There is therefore an urgent need to transfer the process of learning from being teacher-centered to student- centered. This means that the student have to be more independent in doing their work so that they will be able to learn and obtain the needed knowledge needed by their profession. The description of the use of the open laboratory may encourage schools to adapt this method.

III. OPEN LABORATORY

A. Innovative Method of Using Open Laboratory

An integral part of the open laboratory are the work-stations, which are set up in strategic locations in the laboratory room. A station is equipped with supplies and equipment that an individual student will need when performing a laboratory exercises. So that the number of students using the laboratory may be better controlled, the number of stations in the laboratory room is best limited to fifteen. In cases where a school's funds are low, or equipment is adequate , it is recommended that the school should set up only what it can at first, and added others when it can until the number of work stations are sufficient to serve the need. In due time, the number of work-stations will be adequate.

An open laboratory may be used as soon as the work stations are ready. Unlike ordinary laboratory rooms, the open laboratory is open for the students to use as much as 30-48 hours per week. This means that the student can come in to perform laboratory work any time the laboratory room is open. Where the work stations are not enough, the laboratory room is kept open longer than usual.

While this setup is advantageous to the student because he can come in to work at his convenience, more personnel will be needed to do the extended time. Work students who are knowledgeable in how the laboratory exercises are done are usually hired. It has been noted that the work students who participate in this program profit from the privilege. They get trained and so develop competence, besides earning extra money they can use to pay tuition. The training that the work students get is so beneficial that some senior students volunteer to consist the work students in the open laboratory for free.

An office, near enough to provide easy accessibility to the open laboratory, is provided for the teacher assigned to supervise it. The salary of the work student usually comes from the savings made in reducing the teacher's salary when they teach the open laboratory. The reason the salary of the teacher is deducted by one credit hour for every three hours of contact is that the teachers will not usually supervise the laboratory class. Instead it will be the work students who will supervise the work of each student in the laboratory. The main duties of the laboratory teacher of an open laboratory class are the following: grade the laboratory report of each student, check with the work student if the student did his laboratory work. To check the work of the student the teacher also gives practical examinations to find out if the student knows how to do the laboratory and if he/she actually performed the laboratory exercise. The teacher may even require a student or group of student to do a project using the equipment of the laboratory in relation to the subject matter covered in the laboratory class.

The teacher will also be responsible for the giving of the final grade of the student. The student enrolled in the open laboratory is usually oriented in the use and operation of the equipment. The student is also trained in safety precaution when using the laboratory equipment. The student is finally informed that if he/she cannot solve the problem they should seek the assistance of the student assistant and teacher. The student is made to understand that after he/she has done his laboratory work he/she should submit his/her laboratory work to the teacher so that it can be graded.

When the work is completed all the students are be able to learn because he/she individually performed the laboratory exercise.

B. Advantages Of Using The Open Laboratory Method

The main and foremost advantage of using the open laboratory method is that students will have to learn in order to pass the subject. In ordinary laboratory classes a student can always copy a fellow students notes since they belong to the same group. In a typical open laboratory class the student cannot do this since he/she has to independently do the laboratory exercise. The results obtained in the open laboratory class will not be the same as the work of students who merely copy the results of other students. In order to pass the subject the students will have to learn and this can be done by doing the laboratory work individually.

The second advantage is that the student will learn self-discipline. Although there is no specific time a student must do the laboratory exercise, he is under obligation to perform it a time convenient for him to do so; otherwise, he fails. Such a situation develops self-discipline, a skill which, if thoroughly learned, will greatly help the student in the practice of his profession.

The third advantage is the open laboratory allows the student to perform the laboratory exercise any time he/she is free. This allows the student leeway to undertake the laboratory exercise when he/she feels the time is right to do it. In a typical laboratory class the student is required to do the specific laboratory exercise in a specific time and therefore the student is force to do the laboratory work even if the student is busy or is not prepared to do so.

The next advantage is that the open laboratory allows the college to maximize the use of the laboratory equipment in a one-to-one basis. This is not usually possible in a typical three-hour laboratory class. The maximizing of the laboratory equipment therefore creates a win-win situation in the laboratory class. The students are able to individually use the equipment and therefore learn. On the side of the school the equipment is used to a maximum therefore justifying the reason for its purchase.

The reasons given justify why it is advantageous to use the open laboratory method to maximize the learning process of the student. At the same time it allows the school to deliver quality laboratory education.

As stated the final advantage is that everybody wins in using the open laboratory method when undertaking laboratory exercise.

C. Disadvantages and Problems of Using The Open Laboratory Method

If an analysis of the possibility using the open laboratory method is undertaken, several problems will be encountered. The first is that Administration, Dean, Faculty as well as students must be convinced that the open laboratory method will work and be beneficial to all. Unless this is done open laboratory method will never be used in any school.

The next problem is the need to have an adequate laboratory room to hold the open laboratory classes. What the school may have at present may not be adequate for the needs of the open laboratory. As mechanism to see to it that the laboratory room is adequately secured from nonlaboratory students should also be provided.

Another disadvantage is that students will not be able to work in teams or groups anymore. This will therefore minimize the students learning through team work. The communication skills of the students, especially oral, will also be minimized because of a lack of group work.

The last problem is the operation and staffing of the laboratory room. Since the laboratory room has to be opened eight to ten hours a day, additional personnel will be needed. The technician or work students who will operate the laboratory should also be competent and knowledgeable in supervising the laboratory work being undertaken. In fact they should know how to undertake all the laboratory exercise themselves. Since they will be the only ones stationed in the laboratory room they should have the command and the respect of the students taking the laboratory class. They should be competent enough to know if the laboratory equipment is not used properly when students are using it.

What has been given are just some of the problems and disadvantages of open laboratory method. The solutions have been given but it is the will of all concerned that is crucial. Without the commitment of the Administration, Dean, Faculty and finally the students the use of the open laboratory method will fail.

IV. CONCLUSION

The decision to adapt or not to adapt open laboratory to teach laboratory subjects will depend on Administration, Dean, Faculty and the students. It is very important that this people will be fully committed to adopt the method of open laboratory if it is going to be successful. A lot of problems may be encountered but a final decision will always show that in adapting the method students will learn more in laboratory classes compared to ordinary form of undertaking laboratory classes. In order to minimize the problems that the college may encounter it is advised that the Dean take a look at the operation of the school adopting the open laboratory method of instruction and evaluate the results if it can also be used by the school.

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AUTOMATED IDENTIFICATION AND SECURITY SYSTEM FOR ECE LABORATORY

by
Cajita, Modesto Trexine
Alguidano, Ramon Jr. A.
Soriano, Melanie
Sarmiento, Julius

Abstract: ***The population of ECE students of Central Philippine University (CPU) is increasing and the staff of ECE Lab has the hard time monitoring students who want to access the Lab. Laboratory teachers usually require the laboratory assistants to record the time duration the student uses the laboratory. Manual log-in and log-out is done for this purpose and it cannot be avoided that sometimes this system gives erroneous results and take up considerable time. This paper describes our project under Engr. Cirilo C. Calibjo which is a solution to problems inherent to manual log-in and log-out procedures. The objective of the project is to design an automated identification and security system using the M68HC11 microcomputer unit (MCU) of Motorola to remedy the problem. We developed a system which requires two sets of numbers to gain access in the lab., a prototype was made to test the functionality of our design. Although actual field implementation and testing was not possible, the prototype results were encouraging.***

INTRODUCTION:

Laboratory classes, walk-in laboratory classes in particular, are inherent to engineering education and instructors handling laboratory classes often desire to monitor the use of laboratory facilities. This monitoring process helps the teachers determine who among his students are actually performing their laboratory exercises and to answer other questions about the performance of their students. To aid in monitoring factors such as frequency and duration of use of laboratory facilities of students of each student, logbooks have often been used. Although this is the least complicated solution, it is not necessarily the most efficient. Human errors are inherent in such system and takes time specially when the volume of students entering and leaving the laboratory is of considerable size.

The alternative solution to manual log is automation. Automation is best implemented using microprocessors and micro controllers. Automated log minimizes human error since minimal human intervention is required and this also speeds up the process. Automation can be implemented by hardwiring individual logic gates to derive the desire output but this complicates the implementation and introduces inflexibility to the system.

Microprocessors and micro controllers have evolve from simple devices such as the abacus to the complicated mechanical computers of Charles Babbage to the first electronic computer called ENIAC and to the present silicon-based single-chip electronic devices. Microprocessors are VLSI (Very Large Scale Integration) chips, which performs the function of a CPU (Central Processing Unit).

The microprocessor chosen in the implementation of the solution was the M68HC11 micro controller. This reports describes the solution and method of implementation using the M68HC11. The project demonstrates the feasibility of using the M68HC11 micro controller in an automation solution and its capabilities.

General Description of M68-HC11:

The micro controller used in this project is the M68HC11 by Motorola. It is usually referred to as M68HC11 Evaluation Board or EVB. The high-density complementary metal-oxide semiconductor (HCMOS) MC68HC11A8 is an advance 8-bit MCU with highly sophisticated, on-chip peripheral capabilities. New design techniques were used to achieve a nominal bus speed of 2 MHz. In addition, the fully static design allows operation at frequencies down to dc, further reducing power consumption. The EVB requires a user supplied +5, +12, and -12 Vdc power supply and an RS-232C compatible terminal for operation.

The HCMOS technology used on the MC68HC11A8 combines smaller size and higher speeds with the low power and high noise immunity of CMOS. On-chip memory systems include 8K bytes of read-only memory (ROM), 512 bytes of electrically erasable programmable ROM (EEPROM), and 256 bytes of random-access memory (RAM).

Major peripheral functions are provided on-chip. An eight-channel analog-to-digital (A/D) converter is inclined with eight bits of resolution. A synchronous serial communications interface (SCI) and a separate synchronous serial peripheral interface (SPI) are included. The main 16-bit, free-running timer system has three input capture lines, five output-compare lines, and a real-time interrupt function. An 8-bit pulse accumulator subsystem can count external events or measure external periods.

Self-monitoring circuitry is include on-chip to protect against system errors. A computer operating properly (COP) watchdog system protects against software failures. A clock monitor system generates a system reset in case the clock is lost or runs too slow. An illegal op code detection circuit provides a non-maskable interrupt if an illegal op code is detected.

To demonstrate the capabilities of this MCU, the EVB was designed along with a monitor/ debugging program called BUFFALO (Bit User Friendly Aid to Logical Operations). This program is contained in EPROM external to the MCU. The EVB provides a low cost tool for debugging and evaluation of M68HC11 MCU-based target system equipment. It is designed to operate in either the debugging or evaluation (emulation) mode of operation.

System Overview:

The study entails designing a security system that will act as an electronic lock that can be unlocked using numeric data. Unlike ordinary electronic locks were a constant security code is shared by those who are authorized, the system shall require each authorized user of the system to enter a security code unique to each user. The valid numeric code includes the identification number (ID) and personal identification number (PIN). The system also requires continuous power for its operation.

The whole system can be divided into three subsystems namely the PC (personal computer), EVB, and keypad. Sensors and servomotor are also added for efficient implementation of the system. This can be best describe with the aid of Figure 1.

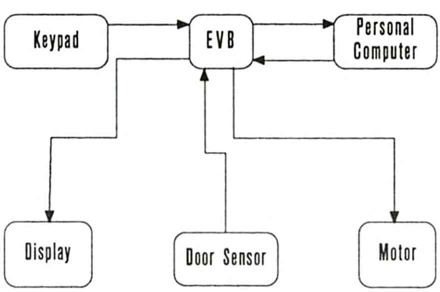


Figure 1. Block Diagram of Automated Identification and Security System.

The system is initiated in the Personal Computer. When the system software is executed in the personal computer, the first thing it does is download the EVB software to the EVB and then commands the EVB to execute the downloaded software.

The software executing on the EVB is the one responsible for accepting and interpreting the data from the keypad. It displays relevant messages, prompts, data, and information on the display. It also senses the status of the door to ensure that the door is closed when it should be closed and open when and only when it should be open.

Operational Description:

The only way that the user can communicate with the control unit (computer) is through the keypad. The circuit for the keypad is shown in Figure 2. The term keypad is applied to an array of keys, usually a small number of keys. In keypad, each key is associated with a particular symbol or binary value. When the key is pressed it generates a corresponding binary code. The keys are arranged in a matrix form. To determine that a key has been pressed, and to identify that key, the matrix is scanned. The matrix is been scanned using the program, by making all the rows of the matrix logic 0 and sensing the logic values of the columns. If one or more columns is a zero, then one or more keys has been pressed. To encode the key, each horizontal wire is, in turn, made logic 0 with all other horizontal wires logic 1.

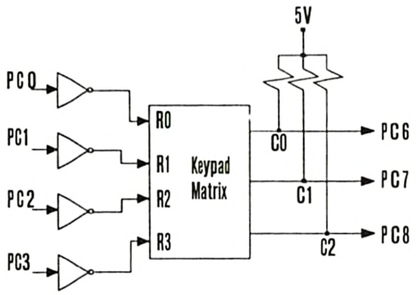


Figure 2. Schematic Diagram of the Keypad

While the horizontal wire is logic 0, each of the vertical wire is examined to see whether it is logic 0. When a vertical line is logic 0, the number of that line, together with the number of the logic 0 row, identifies the key. The rows of the key matrix are controlled by the output port, and its column are sensed through the input port.

It happens that the data needed for this operations is composed of the identification (ID) number and the personal identification number (PIN). The first set of data to be punched on the keypad is the ID number. Through the aid of the program for the keypad, the EVB will interpret whatever number has been pressed on the keypad. Then the EVB will send this data to the computer. The computer will compare the ID number received with the existing data. If it finds a match it will notify the EVB and the EVB will prompt the user to enter its PIN number. The same process as discussed previously will take place. When the ID and PIN number conforms with what is stored in the computer, the computer will send a signal to the EVB to open the door. The EVB will trigger the motor circuit. The door will be opened and there will be a sensor to determine if the door is fully opened for the user to enter. After the EVB sensed (through the sensor) that the door is fully opened, it will also trigger the motor circuit to close the door.

The EVB prompts the user to enter the required code using the display unit. Displays are provided to help the user use the keypad. LEDs with different colors are also installed to guide the user on what to do. The display unit consists of two DL1414Ts and several indicator lights as shown in Figure 3. The display unit can display only 8 characters at a time, limiting the maximum length of strings of characters to be displayed to eight. Using the running lights concept can circumvent this limitation. A string of character of any length can be displayed by scrolling it across the display. The display unit will scroll the string of characters to be displayed across the display in batches of eight. First, it displays eight characters starting at the first character. Then after a precalculated delay, it will display the next eight starting at the second character.

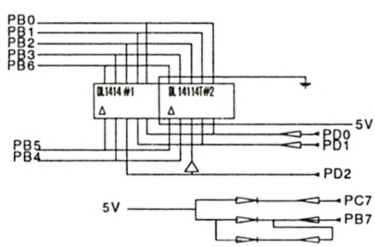
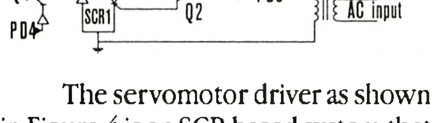


Figure 3. Schematic Diagram of the Display Unit

As stated above, the solution to the first problem in the display unit was to scroll messages of any length across the display unit's eight-character outputs. This solution presents another problem of its own. The M68HC11 chip, the microprocessor used in the EVB, only have a limited number of output ports. A scrolling display requires that each character in the display unit can be access separately and this requires ports. One way to minimize port usage is to multiplex the two DL1414Ts of the display unit and connect all data and select ports in parallel. In able to access a specific character on the display unit, not only will we have to set the select lines properly but also to enable and disable the proper DL1414T. This will require another port. To further save on ports, a single bit is used to select the proper DL1414T instead of two - one for each DL1414T. This can be achieved by using the inverted enable/ disable pin of one DL1414T as the enable/ disable connection of another.

Figure 4. Schematic Diagram of the Servomotor Driver



The servomotor driver as shown in Figure 4 is an SCR-based system that allows the EVB to control the servomotor. It is controls the direction of the DC motor by changing the direction of the current. To allow the current to change directions, two SCRs were used and connected in head-to-tail fashion and supplied with AC power. Although this can also be achieved by using a single triac, two SCRs were used instead to simplify the design. It is easier to use two SCRs since there would two separate gates for control thereby eliminating the need to determine the instantaneous value of the supply voltage. One problem that arose in the design is that the gates of the SCRs would alternately turn on causing the DC servomotor to rattle. To allow the gates to float when no triggering is applied, the SCR gates are connected to and driven by two PNP transistors. When the transistors are off, the gate is effectively floating. The emitters of the transistors are connected to the +5VDC supply. The basis of the transistors are set to +5VDC to turn off the transistors. To switch the transistors on, the base is driven low to ground.

Another sensor will prompt the EVB if the door is forced open. The EVB will also inform the computer that there is an intruder. In this case, the intruder can be apprehended without his knowledge.

The PC is still capable of doing task other than monitoring the status of the security system. The PC system software is designed to perform a type of multitasking - it can handle requests by the EVB for verification of ID numbers and PINs and at the same, perform tasks which the PC operator wishes to do.

If it is desired to monitor the access to a certain room, the system can be modified to coordinate with a log-in program running on the PC. This way, the system is not limited by the microcontroller memory and can store variable log data in the hard disk of the PC for the future reference.

Conclusion:

The prototype was implemented solely for the purpose of testing the functionality of the design and no quantitative tests were conducted. During trial runs, the prototype performed satisfactorily. The following important results are listed in conjunction with the performance of the prototype.

- The design system simplifies the manual log-in and log-out and gives accurate results. It lessens the job of the monitoring staff.
- M68HC11 MCU is relatively easy to work with and have most of the essential features needed for a complete control system.
- M68HC11 MCU has built-in interface capability that is suitable for sensors, actuators, and communications, which makes it more flexible to any automation applications.
- The time clocking of M68HC11 is very accurate.
- A single port of M68HC11 can be used as either input or output ports which then provides more ports for more applications.

Recommendation for Future Work:

Based on observations of the performance of the prototype, several aspects of the solution will have to be modified because few errors are evident. One of the errors was a software bug which came up when a much faster PC was used other than the one on which software was developed. The bug was possibly rooted in the DELAY instruction of the PASCAL language which unexpectedly performed faster than intended. This caused by EVB to log and communications between the PC and the EVB to fail. This bug can be remedied in two ways: use a slower PC or replace the DELAY instruction with an interrupt-driven subroutine dependent on the system clock and not on PC speed.

Another shortcoming of the prototype was the absence of the feedback mechanism in the door system. Since there was no feedback, the MCU had no way of knowing whether the door was actually closed, open, or somewhere in between. A feedback mechanism may be introduced or a totally different mechanism like electrically operated mechanical locks can be used.

Some of the modifications are largely aesthetic in nature like the addition of tone-producing circuits in the keypad, which will produce a tone every time a key is pressed. The system may be further be modified to act as central control unit for the whole room, turning the laboratory into an "intelligent room." It can then control the lighting, locks, and even electrical distribution in the room.

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LOW COST SOLAR HOT WATER SYSTEM

MICHAEL T. TYLER

Mechanical Engineering Department, Central Philippine University

Abstract — ***Solar Hot Water systems are extensively used in some of the more developed countries in the world. They have been subject to much research and are now extremely efficient units. With all of these improvements the cost has escalated to result in units which cannot be afforded in the lesser developed countries. It was because of the high cost that we in Central Philippine University decided to develop a low cost unit, which although not so efficient would be affordable and simple to construct. It should also be designed in a way that it could be used for educational purposes.***

INTRODUCTION

The use of hot water in a piped system within houses in the Philippines is not very common at present. In more developed countries it is widely used. The cost of running these systems is increasing dramatically as more equipment is used in the home that use hot water. The two most common items are the washing machine and the dishwashing machine. It has been proven that the use of hot water for washing dishes, etc. results in much cleaner dishes. There has also been a considerable increase in the use of Spa Baths, these use a tremendous amount of hot water.

Even in countries like Australia, where people are considered reasonably wealthy, it became necessary to develop Solar hot water systems. These are normally used in conjunction with a normal energy consuming unit. Either electrical or gas heated system. The units therefore use solar heating within the daylight hours and the other energy system during the night.

The modern efficient unit uses Ultra Violet stabilized polycarbonate instead of glass and copper for the heat exchanger. This material is also used for the housing together with some reinforcing. This keeps the unit light weight and impact resistant.

Stainless steel for the water tank, insulated with fibreglass. The heating from artificial means is normally controlled by sophisticated electronics. This heats the water when the usage demand is high and maintains the heat during the night hours.

The use of hot water in the Philippines is not as common as in a country like Australia. A fuel saving could be made if the hot water is used for cooking. When cooking a noodle dish for example we turn the gas on high until the water is boiling and then turn the gas down to simmer for three minutes.

Most of the energy is used to bring the water to the boil, if the initial water temperature is raised with solar heating less energy is used.
When bathing, or washing the dishes, the result is cleaner if warm or hot water is used, most of these types of things are normally done with cold water in the Philippines. Therefore this would not produce any cost savings. The benefit in these cases would be improved hygiene.
There are many advantages in using Solar Energy. This is a non polluting energy source, which is provided free. This energy does not have to be imported and therefore assists in the economics of the country concerned. This fuel does not have to be transported.

TYPE SELECTION

There are two main types of unit using the convection method. One is using a pressure system, the second is gravitational (or open) system.
The second system was selected to keep the cost low. A pressure system requires a pressure vessel together with a relief valve.
The gravitational system requires an open tank with a float valve to maintain the water tank level.
These two types use convection to circulate the water, no pump is therefore required, sometimes referred to as passive type.
Other types are available, however these are normally using very large collectors and a pump. This type is normally used to heat swimming pools, sometimes reffered to as active type.

OBJECTIVES

The objectives were to:

1. Manufacture a unit at minimal cost.
2. Produce the unit so that it can be used as a teaching aid.
3. Position the unit so that it can be examined safely by students.
4. Use all locally available products.

LOCATION

The location had to comply with a few criteria:

1. A suitable water supply preferably from an overhead tank.
2. Be able to be fitted where it can easily be viewed, safely.
3. In a predominantly sunny position.
4. Easy installation, with low cost.
5. Close to College of Engineering.

The ideal location for such a unit is directly on the roof of a building. However for this unit it would be impractical, as students could not climb onto a roof to see how it works. A suitable site was located at the power plant area, this suited most of the criteria.

METHODOLOGY

A tank was constructed with a capacity of 120 Litres, this was fitted with a float valve and other pipe connections.

A marine plywood box was made to house the tank leaving suitable space for insulation.

The heat exchanger consists of two main parts, the collector, manufactured from copper tubing in the form of a grid. The housing which consists of a marine plywood boxing with a glass front.

The copper tubing is painted with a dull black paint to absorb as much heat as possible. Dull black paint is around 95% efficient for heat transfer, (white semi gloss is only 30% efficient). These figures are supplied by the U.S. Department of Energy. The housing is lined with aluminum foil to reflect the heat back to the collector.

The housing should have a ventilation area at its lowest point. This will limit the heat loss and allow for expansion of the internal air.

Reference to Heating and Design by Robert Henderson Emerick, indicates that near to the equator the heat exchanger should be angled at 5 to 10 degrees and as much as 60 degrees nearer to the polar regions. These figures are correct in theory, but an accumulation of dirt on the glass would severely restrict the efficiency of the unit.

The mounting of the heat exchanger is such that it should be at an angle so that when it rains the glass will effectively be washed with the water running down. It should not be too sharp an angle so that the water will flow at a reasonable rate to allow suitable heat absorption. The angle selected was around 40 degrees.

Therefore it is a compromise as to the angle selected. As these units would probably used domestically they should for practical reasons follow the angle of the roof of the dwelling. Presuming that it would be exposed to the sun during daylight hours.

The ideal location for the tank is immediately above the heat exchanger. However for practical purposes this was mounted a short distance away. The greater the distance between the heat exchanger and the tank results in greater heat losses. Plastic piping was used for these connections to minimize heat loss.

PROBLEMS

The only problem encountered was for the supply of a float valve. This did not seem to be available in Iloilo.

This was overcome with the use of a standard ball valve, modified by welding some bar to the handle and fitting a float to this.

TESTING

It was decided to test the unit with the lid of the tank not insulated and later with the insulation fitted. This would enable the efficiency of the insulation to be established.

Water usage during the testing was approximately 16 litres per day.

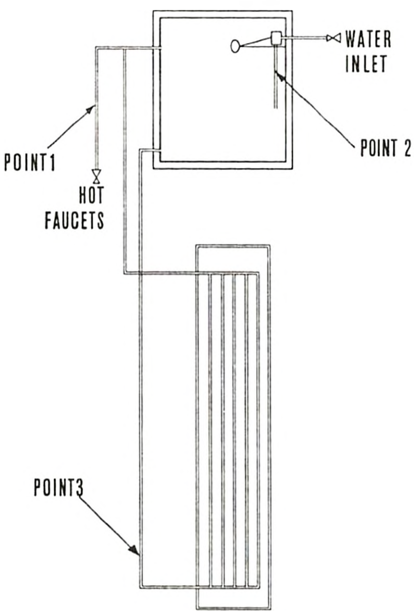
The temperature was measured twice daily, close to 8:30 am and 4:00 pm.

The diagram illustrates the test points, it also gives an indication of the various parts of the system..

TEST RESULTS

The test points where the readings were taken are at POINT 1 the hot water outlet and POINT 2 the cold water inlet.
The maximum gain with uninsulated lid was 25 degrees C and the minimum was 9 degrees C. The average gain in temperature over the temperature of the inlet water was 18.75 degrees Celsius.

DIAGRAM



These readings were taken morning and evening, the system had no insulation on the lid of the hot water tank. This was a piece of plywood laid on top of the tank. The purpose of this is to evaluate the quality of polystyrene foam as an insulation medium. The second and final results were with the lid insulated.
A typical warm sunny day will give result as below:

AMBIENT	OUTLET	INLET	GAIN
31	48	24	24

The second set of test results with the lid insulated were as follows:
Maximum gain was 28 degrees C.
Minimum gain was 16 degrees C.
The average gain was 23.1 degrees C.
A typical warm sunny day will give result as below:

AMBIENT	OUTLET	INLET	GAIN
31	53	25	28

The recovery rate when 8 litres of hot water is drained for the system is as low as 25 minutes on a hot sunny day, and as long as 70 minutes on a dull cloudy day. Even on days with heavy rain for the whole day a temperature increase of 16 degrees C is reasonable considering the cost of this unit is around 1/10 of the cost of an imported unit.

CONCLUSIONS

The Styrofoam used was a high density type used for the packaging of computer monitors. This type is suitable for impact cushioning but a low density foam would probably insulate the tank better. This foam should probably be cumbled to enclose more air pockets for improved insulation. The overseas Solar Water Heaters use fibre glass insulation which is obviously superior but is costly in the Philippines.
Although this unit would be considered low in efficiency. If it is related to the cost of the unit, it is far more efficient than commercially available units. When they are rated against cost of the

unit. It therefore has potential for manufacture in the Philippines.

A point of consideration is that when this system is used for bathing it should be combined with cold water. Temperatures above 40 degrees C become uncomfortable.

Therefore proper mixer units would be required for showers, the alternative would be the inclusion of non return valves. It would be a disaster if faucets are turned on and the cold water pressure is higher than the hot water pressure. The result could be for the cold water to enter the hot water tank through the outlet, resulting in overflow of the hot water tank.

The manufacturing process would be very simple, suitable for individual units or on a semi-automated system of manufacture. Very little specialized training would be required for individual manufacture.

Installation of the Solar Hot Water system should be simple for most homes, however the pipework to the faucet outlets may be more difficult. This should not be too long and preferably should be insulated or as a minimum requirement should be plastic suitable for the temperature of the hot water.

The level of sophistication used in the modern overseas units is not required at present in the Philippine environment.

The climatic conditions in the Philippines makes this type of unit suitable for present day needs.

RECOMMENDATIONS FOR FUTURE IMPROVEMENTS

The initial work has now been completed. There is a need however for further improvements. The heat exchanger is an obvious area for future development. The use of plastic pipe sliced lengthwise in half and the inside covered with aluminum foil would reflect the heat to the copper pipe. This could result in considerable improvement in efficiency.

The effect would be similar to a parabolic mirror, ensuring that the maximum amount of heat is reflected to the copper piping.

A top and bottom manifold could simply be constructed, instead of using Tee pieces and elbows in the copper pipe for the collector. This would probably involve less cost and would be simple to manufacture with the use of a jig. The individual pipes would not have to be cut so accurately.

The Styrofoam insulation for the water tank should be low density, which will improve the heat retention for the tank, or other forms of locally available insulation could be considered.

Consideration could be given to the materials used in the construction of the unit. Also care would have to be taken in the size of the water tank.

For every litre of water the weight increases by 2.2 lbs plus the weight of the tank and housing.

Due to the lack of experience of fitting up and installing units of this type in the Philippines a great deal of guidance should be given to any potential manufacturer. There are many pitfalls. An example of this is some form of indemnity that should a unit be installed and a neighbour builds a two story building next door, creating shade on the unit. The system will no longer work efficiently.

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Contents