SIMULATION MODEL CAR BRAKING SYSTEM IN SMK WIDYA DIRGANTARA

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ABSTRACT

SMK Widya Dirgantara established in 1986 and located at Jl. Bojong Raya No.114A Bandung is a private high school that was established by the Education Foundation Widya Dirgantara. This school has some of competency skills, one skill that is taught is the light vehicle engineering that teach about the braking system.

Based on Central Bureau of Statistics from 2010-2014 traffic accident still remains high, one of the problems of traffic accidents by car is driver lost concentration and can not doing braking. And when the idea of pouring or implementation braking technology, a prototype model to be built will require a relatively large costs for construction only to be used as learning in school.

Based on the existing problems, will design a simulation model that can be poured or implements the idea of a car braking system technology into model which does not required hugh cost in the manufacturing, but enough toi represent technology concept that want implemented by using the Arduino microcontroller as a controller and the Android system works as media information.

Keyword: *SMK, Braking, Simulation model, Arduino, Android.*

1. INTRODUCTION

SMK Widya Dirgantara established in 1986 and located at Jl. Bojong Raya No.114A Bandung is a private high school that was established by the Education Foundation Widya Dirgantara. This school has some of competency skills, one skill that is taught is the technique of light vehicles that teach about the braking system.Braking system is one of the subject in eleventh grade technical high school (SMK). Based on curriculum the subject include introduction, principles brake, types of brakes, the mechanism, and troubleshooting like : brake designed to reduce speed and stop the car or probably park the car in way down. This equipment is very important on vehicles and can be function as safety equipment and ensure safe driving.

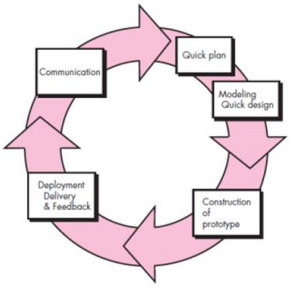
One of the problems of traffic accidents by car is driver lost concentration and can not doing braking. Based on Central Bureau of Statistics the number of traffic accidents which caused by car driver from 2010-2014 still remains high. From the data, there is 3 factor that caused the accidents is driver, car, and environment. From that factor, turned out to be the biggest cause of accidents is human error. If observed further, accidents by car driver more than 75% is cause human error. Large number of vehicles in street sometime not followed by driver awareness to obey traffic signs or respect fellow road users. Indiciplined by driver can endangering other driver [1].

At this time, There are car-based automatic braking system which has been widely applied in recent car like *Ford*, but if only used for learning about the braking system for sure is expensive.

Based on the existing problems, will design a simulation model that can be poured or implements the idea of a car braking system technology into model which does not required huge cost in the manufacturing, but enough to represent technology concept that want implemented, and dynamic and easily when needed the additional features, component changes, and development used to describe the car's braking system by using the Arduino microcontroller as a controller and the Android system works as media information. With this simulation model, hopefully can be used as reference and tools for light vehicle engineering students in SMK Widya Dirgantara to better understand the concept of a car braking.

1.1 Method of Software Development

In this research, Method of Software Development is using prototype method. Prototype method is one of method of software development to identify the needs of the software produced [2]. With this method, developer and user can interact with the system during manufacture. Prototype paradigm help user and develop to have better understanding of what will be built, so if there is a change in a prototype user needed then at the same time also the developer should understand the needs of users better. We can see the model of prototype in picture 1



Picture 1 Prototype Model

This prototype model highly suited for applications requiring high-risk conditions where the problems not well structured, there are fluctuations in the needs of users who change from time to time or unexpected, when a user interaction with an absolute requirement and the time available is very limited so it took immediate settlement. This model can run up to the situation where the expected system is innovative and up-to-date while relatively brief phase of use of the system.

Here are the stages of the development process in prototype model:

a. *Communication*

In this research, requirements gathering done by interview with school representatives to obtain data that supports the design of the simulation model car braking system like learning materials about braking system on the car.

b. *Quick Plan*

In this step, do analysis for hardware requirements, software requirements that can used in designing simulation model.

c. *Modeling Quick Design*

In this step, do system architecture design, analysis of functional requirements, application design, and semantic network.

d. *Construction of Prototype*

In this step consists of two stages of encoding thers is encoding for *Arduino* (as a connector between *Android* with tools) and encoding for *Android* (presentation application)

e. *Deployment Delivery and Feedback*

After the system has become a ready-made software, then doing testing proccess to determine the performance whether an error occurred or not. In this research *black box* as testing process.

1.2 Model

Model is a pattern (exmaple,reference,variance) of something that will be created or generated.

1.3 Simulation

Simulation is a training method thar demonstrated in the form of mock something similar to the actual state or in other words the depiction of a system or process in the form of characterization.

1.4 Brake

Accordding to Indonesia dictionary, brake is tool to restrain movement or mechanism by way of friction; tool to slow down or to stop the movement or rotation, for example on car wheels [4]. Brake have many types like disc brake, drum brake, hand brake, footbrake,etc.

1.5 Microcontroller

According to Setiawan [8] Microcontroller is an IC with a very high density, where all the parts necessary for a controller already packaged in one chip, usually consisting of a CPU (Central Processing Unit), RAM (Random Access Memory), EEPROM/EPROM/PROM/ROM, i/o, Serial Parallel, Timer, & Interupt Controller.

According to Winoto [8] Ardi "Microcontroller is a microprocessor system which it already contained the CPU, ROM, RAM, I/0, clock and other internal equipment that's already connected and well organized by the factory of manufacture and packaged in one chip that is ready to use, so we dwell program the contents of ROM in accordance with the terms of use by the factory of manufacture".

Based on the definitions set forth above it can be concluded that microcontroller is an IC that is designed or constructed by a very high density, where all the necessary parts of a controller already packaged in one chip, usually consisting of a CPU (Central Processing Unit), RAM (Random Access Memory), EEPROM/EPROM/PROM/ROM, i/o, Serial Parallel, Timer, & Interupt Controller and function as a controller umunya as well as electronic circuits can store a program in it.

1.6 Arduino

Arduino is an electronic circuit that is open source, and have hardware and software that is easy to use. The Arduino can recognize the surrounding environment through various types of sensors and can control lights, motors, and other actuators of various types. Arduino has many types, such as the Arduino Uno, Arduino Mega 2560, Arduino Fio, and more.



Image Source : www.arduino.cc [10]
Picture 2 Board *Arduino UNO*

1.7 Ultrasonic Sensor

Ultrasonic sensor is electronic devices that can change the ability of the electrical energy into mechanical energy in the form of ultrasonic sound waves.

Ultrasonik wave is mechanical waves which have characteristics of longitudinal and typically have a frequency above 20 Khz. Ultrasonic wave can propagate through solids, liquids or gases. Ultrasonic wave is the wave propagation of mechanical energy and momentum that propagate through the third element such as an interaction with molecules and the nature of the medium enersia path. Time difference between sound waves emitted by the re-arrest of these sound waves is a representation of the distance. Ultrasonic wave propagation speed is influenced by several factors such as temperature, pressure, humidity, and radio signals. [9]

It should be considered when using the Ultrasonic sensor to an object is as follows.

a. Shape and Size of Objects

Objects with larger size will reflect more waves than the object that is small so as to provide more precise results. Shape of an object affects the amount of reflection of the reflected object. Objects with a round shape will reflect waves in all directions so that the reflection is captured is becoming weaker. Objects with a flat shape will reflect waves better.

b. Kind of Material

Solid objects made of iron or steel will provide a better reflection than with objects made of wood or cork.

c. Surface patterns

Objects with a flat surface, smooth, and perpendicular to the ultrasonic signal emitted will give reflections that are stronger than the uneven surface.

Picture 3 how the ultrasonic sensor work

1.8 Android

Android is an operating system for Linux-based mobile devices that includes an operating system, middleware, and applications. Android provides an open platform for developers to create their applications.

Android is a mobile operating system that grows in the middle of another operating system that is evolving today. Other operating systems such as Windows Mobile, i-Phone OS, Symbian and many more also offers a wealth of content and the keoptimalan runs on top of existing hardware devices. However, the operating system runs with prioritizing core applications that are built on its own without seeing considerable potential from the application owner. Therefore, the third owner of the application distribution limitations to their platform.

1.8.1 Android Architecture

The Android architecture can be described as shown in Picture 4 and in the outline of the Android Architecture can be explained as follows:

a. *Application* and *Widgets*

Application and Widgets this is the layer where we connect with applications only, where we typically download the application then we do installation and run the application.

b. *Aplication Framework*

Android is "Open Development Platforms" that Android offers developers or give capability to developers to build great applications and innovative.

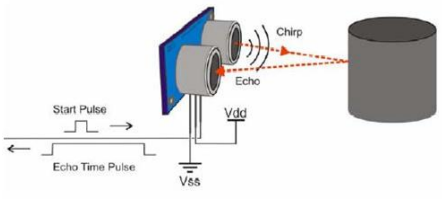
c. *Libraries*

This is the layer where libraries features Android is located, typically the application makers access libraries in order to run the application.

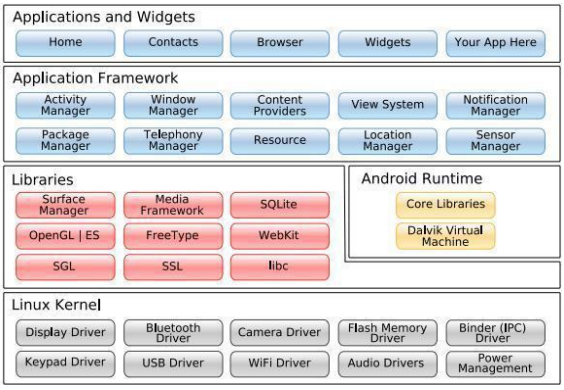
d. *Android Run Time*

Layer that makes Android applications can be run where in the process using the Linux Implementation. Dalvik Virtual Machine (DVM) is the engine that forms the basic framework of Android applications.

e. *Linux Kernel*



The Linux Kernel is the layer where the core of the Android operating system. Contains files of the system governing system processing, memory, resource, drivers, and the operating systems of the other Android. The Linux Kernel used Android is Linux Kernel release 2.6.



Picture 4 Android Architecture

2. MAIN RESEARCH

2.1 Analysis Of The Problem

Simulation model car braking system in SMK Widya Dirgantara is a mechanism designed originated from problems, the problem is the high traffic accident caused by driver's lack of concentration so it does not have time to do the braking. As based on research conducted there are problems that happen so made this system is how to design a simulation model of car braking system to light vehicle engineering students in SMK Widya Dirgantara. Therefore it takes a car braking simulation model that aims to provide an overview

2.2 Analysis System

Simulation model car braking system in SMK Widya Dirgantara is the system used to process car braking by using the hardware and software that is microcontroller *Arduino UNO* that integrated with Android devices via Bluetooth, so as to provide information to users the distance that can be detected and the distance detected after braking.

In designing this system, users of these systems addressed to the teacher or the student light vehicle engineering SMK Widya Dirgantara to guard against misuse of the application in use.

The following analysis of the existing system on Simulation model car braking system in SMK Widya Dirgantara:

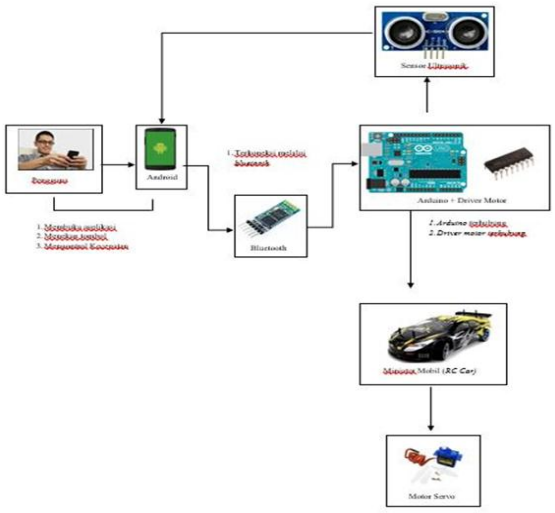
1. The system is controlled via an Android application that connects via Bluetooth.

2. In this application the user can detect the distance through the ultrasonic sensor before and after braking.

3. In this application the user can set the desired speed to simulate braking.

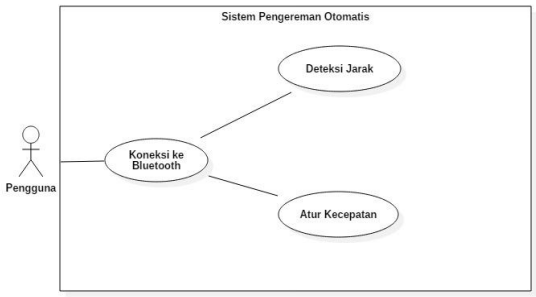
2.3 Analysis Of System Architecture

The design used for Braking System Simulation Model car is like on the picture 5



Picture 5 System Architecture

2.4 *Use Case* Diagram



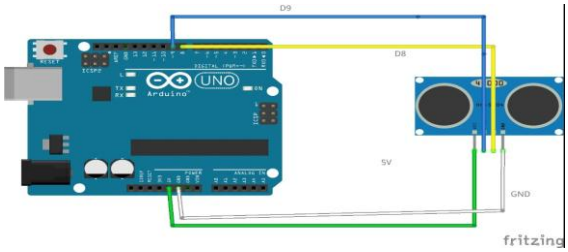
Picture 6 Use Case Diagram

2.5 Microcontroller Device Communication Analysis

Analysis of the communication device is a picture of an Arduino microcontroller with other devices so that the system can be connected to one another.

2.5.1 Communication *Arduino* with ultrasonic sensor

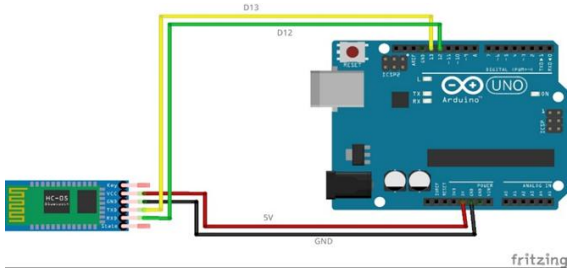
Arduino communicates with sensors Ultrasonic through pin 9, pin 8, 5v, GND. For more details can be seen in the image below.



Picture 7 Arduino with Ultrasonic sensor

2.5.2 Communication *Arduino* with Bluetooth

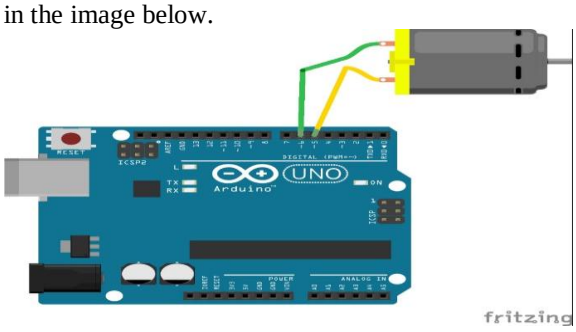
Arduino communicates with Bluetooth through pin 12, pin 13, 5v, GND on *breadboard*, D12, D13, 5v, GND on *Arduino*. For more details can be seen in the image below.



Picture 8 *Arduino* with Bluetooth

2.5.3 Communication *Arduino* with DC Motor

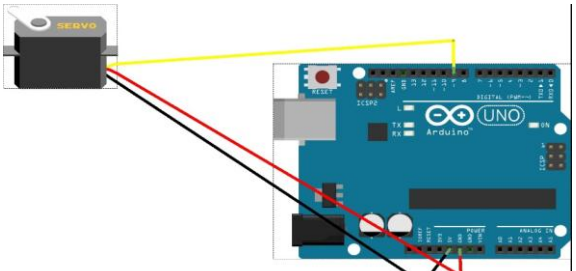
Arduino communicates with DC Motor through pin D5, D6 on *Arduino*. For more details can be seen in the image below.



Picture 9 *Arduino* with DC Motor

2.5.4 Communication *Arduino* with Servo Motor

Arduino communicates with Servo Motor through Pin 9, 5v, GND on *Arduino*. For more details can be seen in the image below.

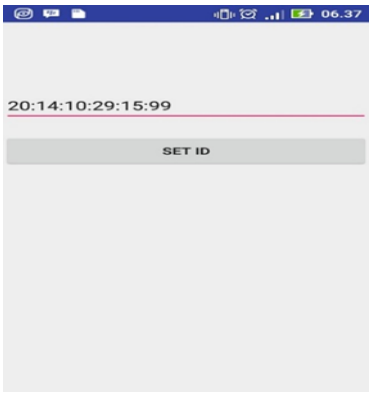


Picture 10 *Arduino* with Servo Motor

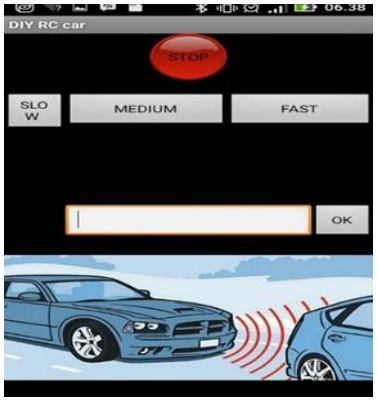
2.6 Interface Implementation

Implementation stage is the translation stage design based on the results of the analysis into a programming language, as well as application software that is built on a real environment. The purpose of implementation is to implement a design that has been made to the application, so that the user can provide inputs for the development of applications that have been built.

Here is an example of the implementation of the interface of software built:



Picture 11 login page Implementation



Picture 12 Menu Page implementation

2.6.1 Hardware Implementation

The devices used in building applications Simulation model car braking system in SMK Widya Dirgantara

Tabel 1 Hardware Spesification

No	Perangkat Keras	Spesifikasi
1	Mikrokontroler	Arduino Uno R3
2	Micro Servo	SG90
3	*Bluetooth*	HC-05
4	Sensor Ultrasonik	HC-SR04
6	PowerBank	Advan

2.6.2 Software Implementation

The software used in the manufacture of application are described in the following table:

Tabel 2 Specifications Software Used

No	Perangkat Lunak	Spesifikasi
1	Sistem Operasi Android	Versi 4.1 Jelly Bean
2	Sistem operasi Microsoft (develope)	Windows 10 Professional
3	Android Studio versi	Versi 2.0
4	Java JDK	Versi 7
5	Android SDK untuk Android	Versi 4.1

2.7 Testing

Testing is done with the aim to find errors and deficiencies in the application under test. The test is intended to determine whether the application is made already meet the criteria in accordance with the purpose of the design is made.

Tests performed are testing alpha and beta testing. Alpha testing is done with black box testing. Black box testing is used to determine the functionally error process, while beta testing is used to determine the user's response or light vehicle engineering teacher at SMK Widya Dirgantara using interviews.

Here is a plan of tests:

Tabel 3 Plan of Test

No	Komponen yang Diuji	Skenario Pengujian	Jenis Pengujian
1	Halaman Login	Koneksi Kke *Bluetooth*	*Black Box*
2	Halaman Menu	Menampilkan Jarak	*Black Box*
		Mengatur Kecepatan	*Black Box*

2. CLOSING

3.1 Conclusion

The conclusion of the research, analysis, system design, implementation and testing of the form of interviews, some conclusions can be drawn as follows:

1. The simulation model can help teachers lightweight vehicle engineering SMK Widya Dirgantara in simulating the car's braking system

2. Overall system on the simulation model has been implemented as expected, from a reading distance, speed setting, which is processed by the processing mikrokontoler up output / output mengesekusi work outcomes of this system

3.2 Advice

Simulation model car braking system in SMK Widya Dirgantara are still many shortcomings. It is therefore necessary for the development and further refinement. As for some advice that may be applied to the Simulation model car braking system in SMK Widya Dirgantara this to be better, are as follows:

1. Using a larger tool so that the simulation is given it will look like the actual car Can add features to capture image manually by the user.

2. Using this type of proximity sensor that has a range farther and have a good sensitivity

3. The output is not only the only braking but the car can maneuver to avoid obstacles

4. Can use the Raspberry PI for faster processing and more features that can be used

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