A Motorcycle Monitor and Control System for Teenager Riders

by Rizal Isnanto

A Motorcycle Monitor and Control System for Teenager Riders

Eko Didik Widianto, Khoirunisa Waskitaningrum*, Rizal Isnanto

Department of Computer Engineering, Faculty of Engineering, Diponegoro University, Semarang 50275, Indonesia

**Corresponding author Email: nisawaskita@gmail.com*

Motorcycles have enormous benefits in supporting transportation. However, they also have negative effects, especially for teenager riders. A motorcycles smart system is required which can improve their rider safety, called Driver Control. Driver Control is built using Arduino Mega 2560 microcontroller, an ADXL345 accelerometer for detecting motorcycles fallen and measuring its speed, an U-blox 6 GPS for locating motorcycles, a GPRS Sim900 for communicating with server, and a relay for controlling motorcycles power system. The data obtained from the system will be delivered to server to be stored and presented to users via web browser or mobile application. The test results show that system is capable to perform motorcycle data acquisition in real time, including its speed, location, and fallen state. The system can also access motorcycle power system as it can turn off or turn on the engine controlled by user request.

Keywords: Driver Control, motorcycle monitor, motorcycle control, fall detection

1. Introduction

Motorcycle riders have some dangerous risks which follow them when ride motorcycle in their daily activities, such as accident, motorcycle robbery, even illegal racing which most teenager takes part on it. Lin and Kraus[1] suggested that parent concern and advisory to their children is an important factor for preventing those happened. It can prevent their children to not take part on motorcycle gang, illegal racing and risk-taking behaviors. Susilo et al.[2] concluded that lots of teenager also become motorcycle accident victims which is dominated by those who doesn't obey the rules and rides carelessly. Furthermore, Motorcycle robbery in Indonesia increases from 41.816 cases in 2012 to 42.508 cases in 2013[3,4].

There are such systems that implement monitoring and controlling motorcycle. Jo et al.[5] developed a Postal-motorcycle Driver Monitoring System (PDMS) and GPS to track movement of the postal motorcycle in real time and measures driving patterns (acceleration, deceleration, average speed, maximum speed, and braking) which may clarify the causes of motorcycle accidents. Watthanawisuth et al.[6] developed a wireless black box using MEMS accelerometer and GPS tracking system. In the event of accident, this wireless device will send mobile phone short massage (SMS) indicating the position of vehicle by GPS system to family member, emergency medical service (EMS) and nearest hospital.

This paper discuss a Driver Control, a system to monitor speed and track position of motorcycle driven by teenagers. Driver Control will send acquired data to a server over Internet network using GPRS modem. The driving behaviors (speed) and motorcycle location will be reported to his/her parents by a server. It can also show the driving activity, fallen warning system in an accident, and motorcycle location information. This system is also can turn off motorcycle engine remotely for security reason.

There are many methods for detecting falling of an object. These methods can be used to detect occurrence of a motorcycle accident. Tang et al.[7] employed accelerometer sensor to detect falling object. It reads transformation value from x, y and z axis. It is mainly used for falling detection on elder with observing scores in 3 different parameters. Clifford[8] employed Low-G and Freefall Linear algorithm to detect object falling. Driver Control uses accelerometer sensor to detect motorcycle accident (fallen) by reading transformation value from x, y, and z axis.

2. Experimental Details

The Driver Control system is designed to be able to detect motorcycle location using GPS and motorcycle accident using accelerometer, track and store motorcycle speed, and give access control to user to turn off and turn on remotely using a smart devices. This system communicates with server via Internet using GPRS module. Motorcycle data from Driver Control will be stored at server and then can be presented to users (parents) using web browser or their mobile phone.

Figure 1 shows the diagram block of Driver Control system. Main control uses Arduino Mega2560 microcontroller[9]. Accelerometer ADXL 345 sensor is used to detect motorcycle fallen state[10]. GPS U-Blox 6 is used to to track and collect motorcycle location[11]. GPRS communication is provided by SIM900 shield module[12]. Data from Driver Control will be pushed to server periodically every less than 1 minute. An accident event will be sent as notification to dedicated users (parents) asynchronously. Figure 2 shows the implementation of Driver Control device.

Driver Control device requires 12 Volts, 1 Ampere for its operation. Motorcycle battery can be used as a power source of the device. Deployment diagram of the device into motorcycle is depicted at Figure 3. Along with relay, the device is used to control motorcycle main power circuitry, so that user can turn on or off its engine remotely.

GPS U-Blox 6 uses asynchronous serial interface to Arduino. This GPS calculation can be done only if the GPS sensor in a lock and valid condition[11]. Accelerometer ADXL345 uses TWI/I2C interface to Arduino. Falling detection uses x, y, and z accelerometer value against threshold. Driver Control uses threshold absolute value 30 found by experiment result of threshold testing concluded in Table I, Figure 7 and Figure 8. The threshold should be guaranteed to not send false fallen alarm when motorcycle crosses even on worst road condition.

Relay, used to control motorcycle power remotely, pulls its locking state data from server. Locking state is presented as "relayOFF" and "relayON" text. If the variable is true and relayOFF is got, then Arduino will turn off motorcycle power by deactivating the relay. Otherwise, Arduino will activate the relay and motorcycle power remains turned on.

GPRS module uses AT commands to communicate with Arduino. Data transaction from Arduino and server is delivered through this module periodically. The fastest time period of data transaction is 54 seconds. There are two tables used in this system. First is *paramTable* table which contains location data, speed data, fallen motorcycle state, date, and time. The second one is *lockTable* table which contains a group of ordered character for motorcycle engine power locking (turn off or turn on).

3. Results and Discussion

Each data and its order from Driver Control system is sent to the server and kept on online database. There are two different table which is accessed by system, which are *paramTable* table and *lockTable* table. Data from Driver Control is pushed to server and stored at *paramTable*. It contains information about location, speed, fallen state, date, and time of motorcycle usage.

The data storing test is done with two different model. First, the Driver Control is placed under motorcycle and the motorcycle moves normally. Second, the Driver Control is simulated under crush by shaking it hard to indicate a fallen motorcycle.

Test result using first test model which is stored periodically every 46 seconds in *paramTable* table. The stored data are latitude, longitude, speed, fall, date, and time information. This test is being done with motorcycle is moving normally and not falling. The fall state value in the table shows 0 (false).

The second test model simulates a fallen motorcycle by crushing or shaking Driver Control it hard. The purpose of this test is getting the indication of fallen motorcycle with accelerometer value beyond their threshold boundary. When system detects motorcycle falling, the system will return 1 value and stores that value in *paramTable* table. The stored data are latitude, longitude, speed, fall, date, and time information. Fall value is 1 (true) that indicates a fallen motorcycle.

The purpose of GPS reading test is to measure accuracy of GPS module used in Driver Control to the latitude and longitude coordinate shown by Google Maps. GPS module show correct location as shown by Google Maps. From datasheet itself, GPS has an accuracy with total error level is ±10m which is big enough.

To determine fall threshold value, data from accelerometer at x, y, and z axis is observed. Driver Control is mounted under motorcycle seat. Motorcycle is driven through 5 sample roads shown at Table I. The system should not send false fallen alarm when pass through those roads. Figure 4 shows the maximum and minimum difference values for each x, y, and z axis when a motorcycle is fallen. Using those data, Driver Control uses 30 as the fallen threshold value.

Power control test is done by sending command from user's web browser. The command will alter *lockTable* value. Driver Control system will read the newest data content in *lockTable* to turn off or turn on motorcycle engine. If the system reads the data content as *relayOFF*, then it will turn off motorcycle engine, while if the system reads the data content as *relayON*, then it will turn off motorcycle engine.

4. Conclusion

Based on functional test results, Driver Control can store motorcycle data to a database table periodically, including location, speed, motorcycle state (fall or not fall), date, and time data. Also, the system is able to turn off and turn on engine remotely in realtime. Driver Control provides facility to enhance the safety of teenager riders. This system also provide facility for parents to monitor their teenagers from danger and negative effects of motorcycle usage. Further development can be done to increase data precision and accuracy using better sensor components although it can rise its cost.

Acknowledgments

The authors would like to express thank to Robotics and Embedded Systems Laboratory of Department of Computer Engineering Diponegoro University that providing all the hardware for making this research possible.

References and Notes

1. M.R. Lin, and J.F. Kraus, Accident Analysis & Prevention 41, 4 **(2009)**
2. Y.O. Susilo, T.B. Joewono and U. Vandebona, Accident Analysis & Prevention 75**(2015)**
3. S. D. S. P. and Keamanan, Statistik Kriminal 2015, Badan Pusat Statistik, Jakarta **(2015)**
4. S. D. S. P. and Keamanan, Statistik Kriminal 2014, Badan Pusat Statistik, Jakarta **(2014)**.
5. J. Jo, H. Kim, H. Park, and D. Yoon, Editors. Smart Mobility for Safety and Sustainability. Proceedings of 2015 IEEE 18th International Conference on Intelligent Transportation Systems, **(2015)** September 15-18; Las Palmas de Gran Canaria, Spain
6. N. Watthanawisuth, T. Lomas, and A. Tuantranont, Editors. Global Grand Challenge of Health Informatics. Proceedings of 2012 IEEE-EMBS International Conference on Biomedical and Health Informatics, **(2012)** January 5-7; Shenzhen, Hong Kong
7. A. Y. C. Tang, C. Ong, and A. Ahmad, Int. J. Adv. Comput. Res. 5, 19 **(2015)**
8. M. Clifford, NXP Free. Semicond. AN3151 **(2006)**
9. F. Perea, Arduino Essentials, Packt Publishing, Birmingham-Mumbay **(2015)**
10. Analog Devices, "ADXL345: 3-axis, ±2g/±4g/±8g/±16g Digital Accelerometer Datasheet (Rev E)", Norwood, United States of America **(2016)**
11. U-blox AG, "NEO-6: u-blox 6 GPS Modules Datasheet", Thalwil, Switzerland **(2010)**
12. "Arduino GSM Shield", **(2016)**. [Online]. Available: https://www.arduino.cc/en/Main/ArduinoGSMShield. [Accessed: 20 November 2016]

Figure captions

Figure 1. Diagram block of Driver Control system design.

Figure 2. Driver Control equipment.

Figure 3. Deployment of Driver Control into motorcycle main power.

Figure 4. Maximum and minimum axis of motorcycle's fall

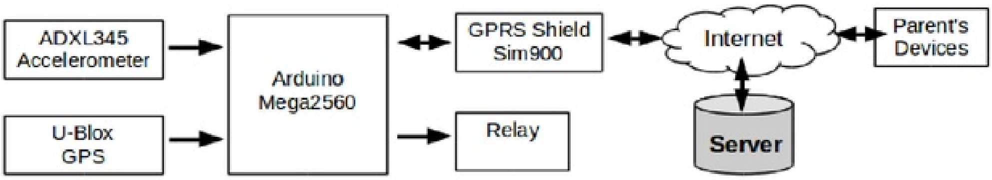

Figure 1. Widianto et al.

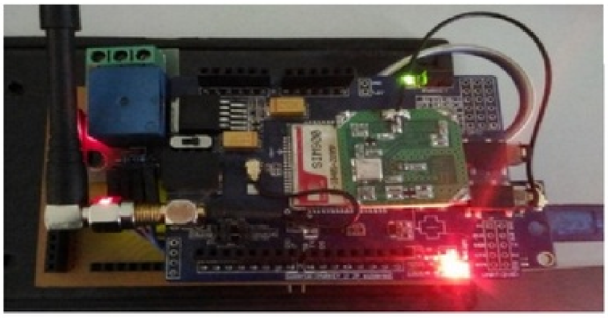

Figure 2. Widianto et al.

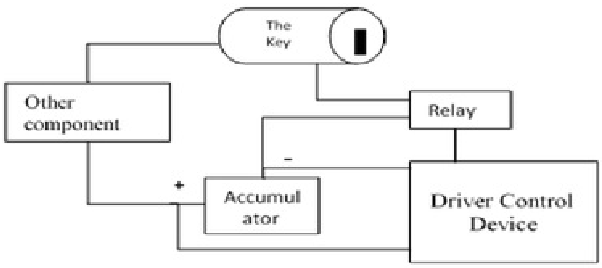

Figure 3. Widianto et al.

Figure 4. Widianto et al.

Table captions

Table I. Threshold Testing

TABLE I. WIDIANTO ET AL.

Road condition	The threshold			
	15	20	25	30
 Sample no. 1	1	1	0	0
 Sample no. 2	1	1	1	0
 Sample no. 3	1	1	1	0
 Sample no. 4	1	1	0	0
 Sample no. 5	1	1	0	0

A Motorcycle Monitor and Control System for Teenager Riders

ORIGINALITY REPORT

%5	%5	%5	%3
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	programme.exordo.com Internet Source	%2
2	Submitted to Higher Education Commission Pakistan Student Paper	%2
3	projectsarena.com Internet Source	%1

EXCLUDE QUOTES	OFF	EXCLUDE MATCHES	< 1%
EXCLUDE BIBLIOGRAPHY	ON		