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MERA (motorcycle emergency ride assistance): plug-in for accident detection and notification

MERA (motorcycle emergency ride assistance): plug-in for accident detection and notification

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Abstract. The condition to trigger the Automatic crash detection for motorcycles is more complex, since the collisions in real life are usually different than those in the lab. so in order to boost the accuracy and affectivity, the researchers must reduce inconsequential deployments, the occupant weight, and riding condition, as well as re-calculate the speed to crash conditions. In this paper was present a continuously evaluates and innovate for crash detection with support automated notification system. The accident detection, communicates the accelerometer, vibration, speed and lean values to the determine accident status and level. In this concept, three different variable measurements are attached to head of the motorist and motorcycle body, Crash dummy tests are done for trial particular systems in helmet by throwing the helmet with different altitudes to simulate the effect of crash to the motorist, and for capture the location of accident, real data is collected by driving the motorcycle. The implemented prototype system showed promising results for automatic crash detection, and the system also showed its success for deliver real-time notifications when an accident was happening.

1. Introduction

Since the response time is very limited to save lives and / or patient's limbs, then the treatment must be handled it with systematic and priority scale based. Measures must be fast, precise and careful according to standards. Therefore, it is clear that to minimize response time the first step is to activate the rescue system (call for help), both for the environment around the event and family and/or related officers. Many different sensory devices are used to determine the position and orientation of an object. The most common of these sensors are the gyroscope and the accelerometer. Though similar in purpose, they measure different things. When combined into a single device, they can create a very powerful array of information. Using quantitative method and descriptive type research, the researchers doing sustainable research to improve the of crash detection and notification system.

The idea adopted from Smart Motorcycle Helmet: Real-Time Crash Detection With Emergency Notification, Tracker and Anti-Theft System Using Internet-of-Things Cloud Based Technology by Marlon Tayag and Maria Capuno [1]. Based on the research finding, To the Smart Motorcycle Helmet is a viable tool or device that can be used to help motorcycle riders in times of emergency. the researchers try to determine the need to develop a smart helmet capable of being a tool to saving the motorcycle rider in times of an emergency such as an accident or collision. That's finding also relevant with studies of pre-hospital emergency medical services, one of them is Frederick B. Roger and Katelyn Rittenhouse research about The Golden hour in Trauma: dogma or medical folklore [2]. In the event of an accident

/ trauma, "the golden hour" begins for the sufferer. Life, death or disability that may occur depends on the speed and accuracy of the first aid provided.

This paper aims to determined how provides an affordable, effective accident detection and notification system to address the aforementioned problems. Mera is a Plug-In of Motorcycle Emergency Ride Assistance for Accident Detection and Notification. Mera itself is integration between the gyroscope and accelerometer sensor with others multiple sensors for measure of collision and impact rate and to know the reason for accidents. The sensors are integrated on motorcycle and helmet, depends on the sensing function. MERA also implemented The GPS for recognizing the location of accident detection, and GSM-Based Notification System.

2. Method

The research methodology in this journal is carried out by using an experimental-based Modelling and simulation approach of several sensor sets that is combined as an input in detecting event parameters [3]. The first, all experimental research designs are based on comparison between two or more scenario groups. These groups must be composed of subjects who are similar on all characteristics which might influence the outcome of interest; otherwise, it is impossible to rule out the possibility that any observed differences at the end of the experiment were due to baseline differences between the groups at the start of the experiment. The experiment scenario is Simulation accident base on single variable, Simulation accident base on all stimulant variables, Performance Measurement the hardware and system, Accuracy using study comparison.

3. Results and Discussion

The system architecture in The MERA Tech are following 3 process. *Step 1*, Accident Detection Process: This phase is the stage of detecting an event that has the potential to be an accident. The process of determining the potential for an accident is determined based on the suitability of the parameters that represent the criteria stated as an accident. These parameters are obtained from the sensor readings placed on motorcycle, namely the Lean-angle sensor with a parameter size> 60^o based on best practice from the Validation of Equations for Motorcycle and Rider Lean on a Curve research by Neal Carter, Nathan A. Rose, and David Pentecost [4] and collusion sensor [5]. Whereas in Helm using accelerometer, speed and vibration sensors.

Step 2, Determinate status accident: The system is in the state of Always-On Monitoring, it's a reference to the system providing the ability to always check conditions and parameters in real-time, therefore the system can monitor critical target status and metric alerts. In particular the results of sensors avoidance are from the physical environment. Next, the analysis step, if the data sensing results from the sensors meet the conditions in accordance with the specified parameters, then the system can run the Emergency Action (alerts and notification) procedures. In determining the status of emergency conditions divided into 3 conditions, The category of light weight with collision value reading at < 1000 Hz; speed is above 5 Km/hour while speed is less than > 60^o; The category of emergency with collision value reading between ≥ 1001Hz to 3000Hz; speed is above 5Km/hour while speed is less than > 40^o; The category of heavy with collision value reading at ≥ 3001Hz; speed is above 5Km/hour while speed is less than > 60^o. The basis for minimum collision value reading received on the helmet that is based on the peak value of maximum impact on the energy that is passed on by the helmet set by SNI (Indonesian National Standard) 1811: 2007 with a magnitude of not being able to exceed 300 G (gravity) [6].

Step 3, Logging and Notification : In this phase, the system can store the entire sensor data sensing in internal Random Access Memory (RAM) during the analysis process for execution of programs, and if the full parameters are used, then the corresponding data is stored in external storage [7]. Then the system can execute the Emergency Action (alerts and notification) procedure to the numbers that have been registered on the system. SMS Notification contains location data of event occurrence including the capture of sensor data which indicates the existence of emergency in the form of Executive Summary of Incident Report.

Microcontroller [8], Used in the design of this research system requires a voltage between 6-12V. The output power of the battery used is 3.7V. To connect the battery is with a microcontroller power line. Examination procedure that is done as the following Measure Output power battery when in charge, target 3,7V-4,2V. Measure Output power Charger Module, target between 3,7V-4,2V. Measure Output power Battery after charge, target 3,7V-4,2V. Measure Output power out using Step Up module, target 6V-12V. 5) Calculate total of power consumption.

Accelerometer Sensor Circuit on MERA use the MPU 6050 Accelerometer. the MPU6050 has both 3 Axis accelerometer and 3 Axis gyroscopes integrated on a single chip. Testing the Accelerometer Sensor (3) MPU 6050 as shown in Figure 2 is done to find out whether the sensor can work for the detection angle as expected. The application used as a comparison for reading sensor values is an Arduino-based application that is integrated with a protractor. Testing is done by connecting the Sensor Accelerometer MPU 6050 microcontroller. In the operation of this sensor Arduino requires Library wire.h. Arduino will communicate through the I2C ports found on pins A4 and A5. The following is an explanation of the program code used to run the sensor *Accelerometer*.

```
axis_X = Wire.read() << 8 | Wire.read (); axis_Y = Wire.read () << 8 | Wire.read ();
```

The function above is to read the data sent by the sensor to Arduino. The data that has been obtained is converted to an angle of -90 and 90 by the function below; this is required for the atan2 function. The atan2 function is a function used to find the value of an arc tangent or the opposite of a tangent whose value is derived from an X coordinate and a Y coordinate. A tangent is the quotient between the flat side and the vertical side of a right triangle.

```
int xAng = map (axis_X, minVal, maxVal, -90, 90); int yAng = map (axis_Y, minVal, maxVal, -90, 90);
```

The atan2 function converts the value to Radians [9], for that it needs to be converted again into degree reading with the RAD_TO_DEG function. This function converts 360-degree readability. The X angle is the right-left slope while the Y angle is the front-back slope.

```
x = RAD_TO_DEG * (atan2(-yAng, -zAng) + PI); y = RAD_TO_DEG * (atan2(-xAng, -zAng) + PI);
```

Then to facilitate the reading and calculation in determining the angle parameters, 360 degrees are converted to 180-degree readings with the functions below. An angle reading when it exceeds 180 degrees can be read a minus value, so 360 degrees can be read -180 degrees.

```
if (x > 180) {x = x - 360;} if (y > 180) {y = y - 360;}
```

Voltage measurement and Current consumption use two Digital Multimetres with different Brands to be able to compare the readable value. The first Digital Multimetre uses the Fluke type 117 and the second Digital Multimetre uses the Fluke DT9205A. From the Power Supply test results use the Multimetre Fluke type 117, the resulting voltage looks like table 1 below:

Table 1. Results of testing the voltage power supply using fluke type 117

	Output Power (Volt) From				**Consumtion Power**
Exam	**Adaptor**	**Charger Module**	**Battery**	**Step Up**	**(mAH)**
1	5.122	4.156	4.137	7.26	180.6
2	5.122	4.156	4.137	7.26	180.6
3	5.122	4.149	4.137	7.26	180.6
Avg.	5,122	4.153	4.137	7.26	180.6

From results of Multimetre 1, the voltage values generated by the power supply the system requirements. Result following table 1 and 1, Data from Multimetre 2 shows the voltage released meets the system requirements. From the results of reading the two Multimetre data that is read is not significantly adrift but Multimetre1 provides better accuracy of reading values up to three digits behind the comma than the reading of Multimetre 2.

Table 2. Results of testing the voltage power supply using fluxe DT9205A

Exam	Output Power (Volt) From				Consumtion Power (mAH)
	Adaptor	**Charger Module**	**Battery**	**Adaptor**	
1	5.12	4.12	4.13	7.25	180.6
2	5.13	4.13	4.13	7.25	181.2
3	5.12	4.13	4.14	7.25	180.6
Avg.	5.12	4.12	4.13	7.25	180.6

The results of the average voltage and current measurements can be calculated with the following formula:

$$\boldsymbol{Average\ value = Score\ Total \div Amount\ of\ data}[10]$$

From the formula above we get the average value of voltage = 4.137 V on Battery for Multimetre1 and voltage = 4.132V for Multimetre2. So, the average voltage of two Multimetreis 4.1345V and the average value of Current Consumption = 180.79 mAH or Current = 0.18079 A. From the measurement results when the battery is full it has a 4.1345 Volt Voltage with Amperage Specifications on a 650 mAH (0.650AH) Battery. So the power possessed can be calculated by the formula [11], [12].

$$\boldsymbol{Watt\ Battery = Voltase\ \times AmpereHour = 4,1345 \times 0,650 = 2,687\ WattHour}$$

This means that within an hour the battery is able to supply power of 2.687 Watt. As for the total power consumption when the device is turned on are:

$$\boldsymbol{Wattage\ consumption\ = Av.voltage\ \times\ Av.Amperage = 4,1345\ \times 0,18079 = 0,7475\,Watt}$$

Therefore, the measurement results can be calculated theoretically the battery life is:

$$= \frac{2,687}{0,7475} = 3,59\ hours$$

Table 3. Comparison of MPU sensor level 6050 with protractor

Position Angle of the bow	the tool of -X angle	Error angle -X	the tool of -X angle	Error angle -X	the tool of –Y angle	Error angle - Y	the tool of -Y angle	Error angle –Y
0°	-0.06		0.87		0,54		-0,86	
5°	-5.35	7.00	5.19	3.80	5,06	1,20	-4,91	1,80
10°	-10.00	0.00	10.34	3.40	10,34	3,40	-10,58	5,80
15°	-14.63	2.47	15.86	5.73	14,48	3,47	-13,95	7,00
20°	-20.12	0.60	20.73	3.65	21,37	6,85	-20,11	0,55
25°	-24.96	0.16	24.64	1.44	26,74	6,96	-25,29	1,16
30°	-29.33	2.23	30	0.00	30,33	1,10	-30,67	2,23
35°	-35.76	2.17	35.04	0.11	34,89	0,31	-35,37	1,06
40°	-40.66	1.65	39.2	2.00	40,18	0,45	-40,13	0,33
45°	-45.11	0.24	45.52	1.16	44,68	0,71	-45,51	1,13
50°	-49.99	0.02	49.7	0.60	49,53	0,94	-50,13	0,26
55°	-55.22	0.40	54.59	0.75	55,99	1,80	-55,44	0,80
60°	-59.14	1.43	60.91	1.52	62,01	3,35	-60,12	0,20
65°	-64.4	0.92	64.81	0.29	64,31	1,06	-65,46	0,71
70°	-71.82	2.60	71.47	2.10	69,45	0,79	-69,29	1,01
75°	-75.07	0.09	76.19	1.59	76,62	2,16	-75,29	0,39
80°	-77.51	3.11	80.11	0.14	79,86	0,18	-81,69	2,11
85°	-85.68	0.80	85.58	0.68	84,98	0,02	-84,01	1,16
90°	-87.24	3.07	89.87	0.14	89,44	0,62	-88,25	1,94
Average		1.61		1.62		1,97		1,65
Margin of Error (∑ Error angle /n)						1.71		

Table 3 is the result of comparison of angle readings compared to the angle reading of Protractor Applications while table 3 is the result of comparison with reading of protractor. The degree reading of

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the protractor and arc applications is considered the actual angle. Data is taken testing several angles from 0 degrees to 90 degrees with the difference in distance of each., based on The Slovin's Formula as follows: n = N/(1+Ne2), so The average error value that is read between angles of 0 degrees to 90 degrees is 1.71%, it's mean < Error tolerance (5%), in a testing result the suitability of the comparison has an accuracy rate of 95%.

The results of voltage measurements and current consumption by the MPU 6050 sensor when run can be seen in table 4 below. The working voltage of the sensor is 3,299V from Multimetre 1 and Multimetre 2 is 3.3V.

Table 4. Voltage test and current consumption of MPU 6050

Test	Working voltage (V) Multi meter 1	Current Consumption (mA) Multimeter 1	Working voltage (V) Multimeter 2	Current Consumption (mA) Multimeter 2
1	3.299	1.4	3.30	1.4
2	3.299	1.4	3.30	1.4
3	3.299	1.4	3.30	1.4
Average	3.299	1.4	3.30	1.4

From table 4 which contains the results of testing the working voltage and current consumption, the working voltage of the vibratory sensor measured by the average of the two Multimeters is 3.29V. The following is an explanation of the source code used in the SW-420 vibrating sensor. Digital pin The sensor output is connected to the Arduino D5 pin and expressed by the variable vibrate_Pin.

```
int vibrate_Pin = 5; void vibrate() { measurement = TP_init();}
long TP_init() {delay(10); measurement = pulseIn (vibrate_Pin, HIGH);return measurement;}
```

The pulseIn (10) function is a function of reading data from the digital sensor output. Time delay (delay) reading of data from the sensor is for 10ms, if during that time there is no data read, the value is considered **Low or 0**. If there is a vibration value that is read may be stored in the measurement variable. The following Table 4.18 results of the comparison of vibration test values on Motor 1 (dimensions 2,050 x 757 x 1,075 mm and weight 136 kg with 149.2 cc) and Motor 2 (1.873x678x1.074 mm and weight 94 kg with 108 cc).

Table 5. The value of the test results vibrates

Test	Motor Vibrate 1 (Hz))	Motorbike 1 (Hz)	Motor Vibrate 2 (Hz))	Motorbike 2 (Hz)
1	74	52	48	74
2	4	51	74	148
3	426	3	55	74

From table 5 above it proves that the vibration sensor can read the vibration value and can work as expected and following visualization in the form of a vibration reading graph.

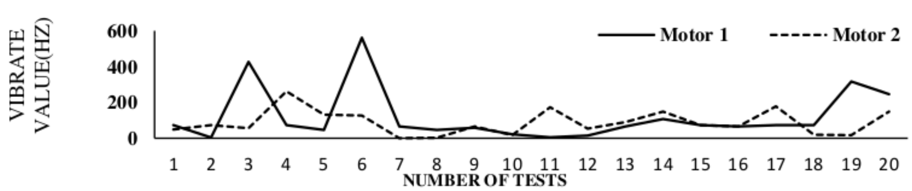

Figure 1. Graph of vibration sensor test results 1

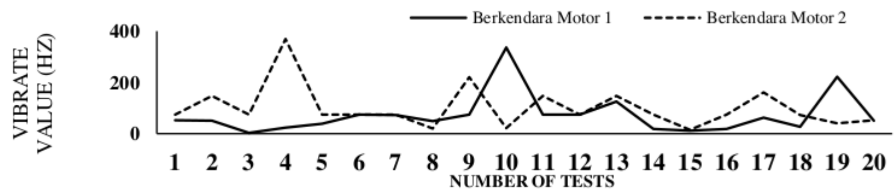

Figure 2. Graph of vibration sensor test results by driving

The results of the reading of the second drive vibrate values of both motors (Figure 1, Figure 2) show fluctuating values because in addition to the influence of engine power motors, the dimensions and weight of the motor state of the road being travelled also affect. From the test results show that the sensor can work as expected.

4. Conclusion

The results of this study can help the process of informing traffic accidents more quickly. Help with accident sufferers can be done immediately. Delay in relief from accidents can result in fatalities to be minimized. Sensors in the system that are vibration speed and angle sensors can work in accordance with the standard parameters set. In tastings with several types of motors there are differences in the results of reading the system, vibration reading for motor 1 when without driving the initial pull is greater than motor 2 because engine capacity in motor 1 bigger than motor 2, then more stable in the middle due to the influence of dimensions and greater motor weight. The results of the second drive reading vibrate the value of both motors show fluctuating values allegedly differences in the reading is influenced by engine capacity, dimensions and weight of the motor state of the road traversed from the test results show that the sensor can work as expected

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