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Design of Passenger Information Display System for Railway

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Abstract**—** *In line with the development of Passenger Information Display System (PIDS) technology, it requires improvements in several aspects in line with needs. The weaknesses of the current Passenger Information Display System include the difficulty of customizing features and handling damage caused by foreign products. Based on this background, the author made "Passenger Information Display System for Trains". PIDS can display information visually and audio to passengers during the trip in real time. This tool is integrated with GPS as input from PIDS, Desktop Based Applications, Emergency Call (PEC) Devices, Online Tracking Applications and Data Loggers. GPS will continue to be updated, so that it can display real time data to train passengers, so passengers do not worry about being left behind. Based on the results of the PIDS test, it can display or convey information visually and audio to passengers in real time. Emergency Call (PEC) devices, online tracking applications and data loggers function as expected.*

Keywords**—** *PIDS, Database.*

I. INTRODUCTION

In line with the development of Passenger Information Display System (PIDS) technology, it requires improvements in several aspects in line with needs, both to meet passenger needs and for ease of maintenance and repair. The weaknesses of the current Passenger Information Display System include the difficulty of customizing features and handling damage because the products used are foreign products. Some features are intentionally restricted or protected, resulting in dependence on the use of foreign products.

Based on this background, the authors make a device "Passenger Information Display System for Trains" which can be customized and easy to maintain and repair. This tool is integrated with GPS which is controlled using Arduino Uno as input from PIDS. The coordinates obtained will be compared with station data to obtain station estimates. The data will be centered on the localhost database. Information will be conveyed visually and audio to passengers. GPS will GPS update every second, so that it can display real time data to train passengers, so passengers do not worry about being left behind with information.

II. METHODOLOGY

2.1 System Diagram

The system diagram of PIDS is shown in Figure 1.

1. GPS is used to obtain longitude, latitude, and speed coordinates.
2. Arduino Uno 5 is used for GPS control. The data received by the GPS module is sent to Arduino Uno 5 serially. Then Arduino Uno 5 sends GPS data to the train server localhost database.

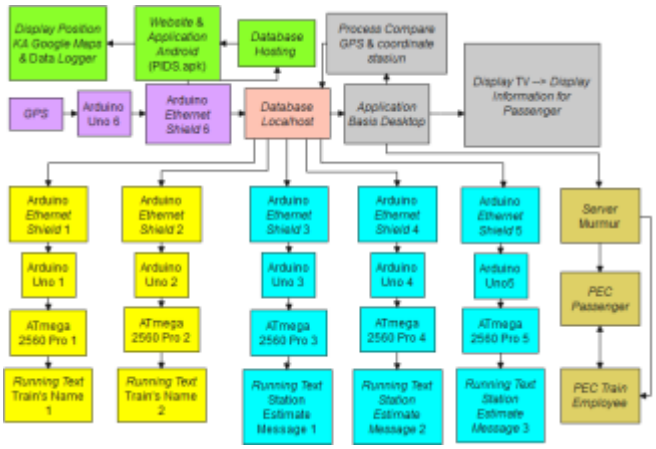

Fig. 1. PIDS design system diagram

3. The desktop based application will display GPS data and station longitude data for comparison with logic. So that it gets train route information, estimated arrival time, speed, estimated distance to arrive and estimated station messages. The data will be centered on the train localhost database.
4. Arduino Uno 1 & Arduino ATmega 2560 Pro 1 are used to control train running text 1. Arduino Uno 1 will retrieve the train name data from the localhost database, then send it to Arduino ATmega 2560 Pro 1 serially to be displayed on running text P10.
5. Arduino Uno 2 & Arduino Atmega 2560 Pro 2 are used to control train running text 2. Arduino Uno 2 will retrieve the train name data from the localhost database, then send it to Arduino ATmega 2560 pro 2 serially to be displayed on running text P10.
6. Arduino Uno 3 & Arduino Atmega 2560 Pro 3 are used to control running text estimation of station 1. Arduino Uno 3 will retrieve station estimation message data from the localhost database, then send it to Arduino ATmega 2560 Pro 3 in serial to be displayed on running text P10.
7. Arduino Uno 4 & Arduino Atmega 2560 Pro 4 are used to control running text estimates for station 2. Arduino Uno 4 will display station estimation message data from the localhost database, then send it to Arduino ATmega 2560 Pro 4 in serial to be displayed on running text P10.
8. Arduino Uno 5 & Arduino Atmega 2560 Pro 5 are used to control station estimation running text 3. Arduino Uno 5

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will display station estimation message data from the localhost database, then send it to Arduino ATmega 2560 Pro 5 in serial to be displayed on running text P10.
9. The MurMur server is used for the PEC control center.
10. TV display is used to display train route information, estimated arrival time, train speed and distance traveled.
11. Running text P10 is used to display the train name and the estimate to the station.
12. Online Tracking and Data Logger application to monitor train position and save logger data during train travel.

2.2 Software Design

This section will explain about the PIDS software design. The software desaign of PIDS is show in Figure 2.

Fig. 2. Software system flowchart

Figure 2
A = From the GPS input to the localhost database on the train server computer
B = Comparison of GPS data with station data to decide on the estimation result of the station and appear on running text P10
C = Connect the train localhost database to display the train name in the P10 running text
D = Connect PIDS server to be able to communicate via chat room and via voice
E = Connect database hosting to get GPS data then process it so that the online tracking and data logger website appears.

2.3 Passenger Information Display System

The framework of the workbench is used for the design of the Passenger Information System on a lab scale.With a table frame area of 200cm × 47.5cm × 200cm.The screen frame area is 200cm × 124.8cm.The area of the table frame is 200cm × 47.5cm.

The implementation of this PIDS shown in Figure 4.

Fig. 3. PIDS design

Fig. 4. Implementation of PIDS

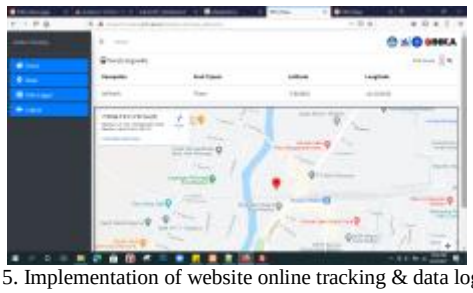

Fig. 5. Implementation of website online tracking & data logger

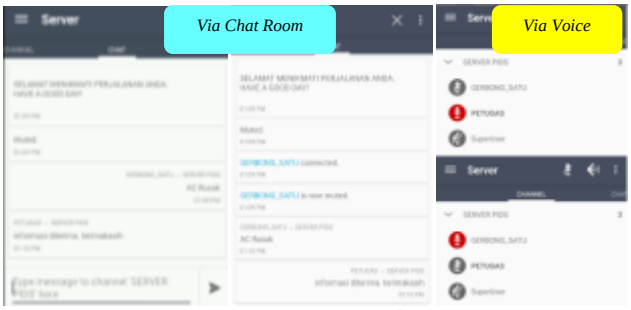

Fig. 6. Implementation of PEC

2.4 Global Positioning System

The Global Positioning System (GPS) is a satellite-based navigation system. How it Works GPS uses a number of satellites in earth orbit, which transmit the signal to the earth and captured by a signal receiver. GPS requires transmission from 3 satellites to obtain two-dimensional information (latitude and longitude). Latitude (latitude) is an imaginary line drawn from the north to south pole. Starting point 0-180 degrees and vice versa. Longitude is the horizontal line. Point 0 is the equator angle. Sign "+" = direction of the north pole. Sign "-" = direction of the south pole.

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2.5 Running Text

Running text is an electronic medium that helps make it easier to convey information. Running text in the form of LEDs connected and assembled into a dot matrix.

2.6 Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P.Arduino Uno contains everything needed to support a microcontroller.Just connecting to a computer via USB or providing DC voltage from a battery or AC to DC adapter can make it work.

2.7 Arduino Ethernet Shield

Ethernet Shield adds to the Arduino board's ability to connect to a computer network. Ethernet Shield based on the Wiznet W5100 ethernet chip. The Ethernet library is used in writing programs so that the Arduino board can connect to the network using the Ethernet Shield.

2.8 Arduino ATmega 2560 Pro

The Mega Pro Mini CH340G / ATmega 2560 board is based on the ATmega2560 microcontroller and the CH340 USB-UART adapter. To connect Pro Mini to PC one must use a USB-TTL converter. The board can be powered via the Vin power pin. The maximum output current at 5V is about 800mA, at 3.3V it is 800 mA.

2.9 Comparison Method

A method used to compare the data drawn into new conclusions.

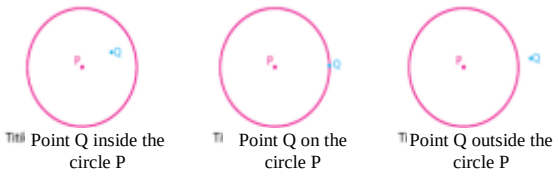

Fig. 7. Comparison for station stops

The point is on the circle if $(x - a)^2 + (y - b)^2 = r^2$ (1)
The point is inside the circle if $(x - a)^2 + (y - b)^2 < r^2$ (2)
The point is outside the circle if $(x - a)^2 + (y - b)^2 > r^2$ (3)

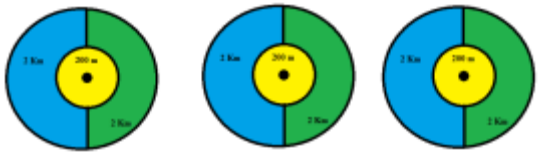

Fig. 8. Range scheme for station stops

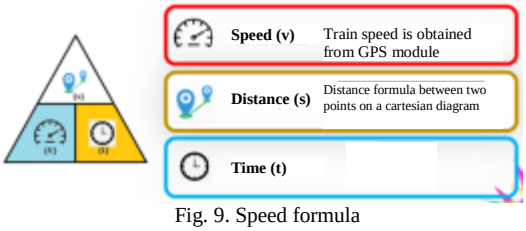

Fig. 9. Speed formula

$$\text{Distance} = \sqrt{(X1 - X2)^2 + (Y1 - Y2)^2} \quad (4)$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} \quad (5)$$

2.10 MySQL

MySQL is a database server program that is capable of receiving and sending data very fast, multi-user and using basic SQL commands (Structured Query Language).

III. RESULT

3.1 Result

The power consumption needed to operate is 90.875 Watt and data consumption is 312 Mb / day. PIDS is able to convey information visually and audio in real time.

TABLE 1. PIDS test results

No.	Testing Aspect	Result
1	Application basis desktop	Application basisdesktopable to display train routes, distance traveled, speed, estimated time of arrival
2	Train running text	Train running text Able to display train name
3	Station estimation running text	Station estimation running text able to display station estimation message
4	PEC	PEC Able to communicate via voice and via chat room between train officers and passengers in carriages
5	Website online tracking andloggerdata	Website online tracking and loggerdataable to display online tracking to monitor train position and store train trip history in the form of longitude, latitude, direction, speed in real time for 30 days.

TABLE 2. GPS test results

No.	GPS		Google Maps		Difference (m)
	Latitude	Longitude	Latitude	Longitude	
1	-7.618212	111.521162	-7.618158	111.521238	8,14
2	-7.616147	111.521494	-7.616229	111.521483	9,26
3	-7.56226	111.451039	-7.562231	111.450944	7,05
4	-7.441768	111.386606	-7.442158	111.386498	8,13
5	-7.418197	111.306637	-7.418387	111.307135	10,24
6	-7.398941	111.224744	-7.398847	111.22447	7,58
7	-7.41911	111.064054	-7.419112	111.063973	8,55
8	-7.42984	111.017821	-7.429319	111.017847	9,23
9	-7.468242	110.947588	-7.468240	111.947527	6,34
10	-7.534079	110.901547	-7.534036	111.901588	7,33
Average Difference					8,185

TABLE 3. Distancecomparisontest results

No.	Comparison	Google Maps	Distance Comparison	% Error
1	Madiun Station –Barat Station	10,25 Km	9,94 Km	3%
2	Barat Station –Geneng Station	8,06 Km	8,34 Km	3,4%
3	GenengStation–Paron Station	7,06 Km	7,31 Km	3,5%
4	Paron Station –Kedunggalar Station	9,12 Km	9,42 Km	3,2%
5	KedunggalarStation– Walikukun Station	9,00 Km	8,71 Km	3,2%
6	WalikukunStation–Sragen Station	23,04 Km	22,14 Km	3,9%
7	SragenStation–Masaran Station	8,75 Km	8,43 Km	3,6%
8	Masaran Station–Kemiri Station	8,95 Km	8,70 Km	2,7%
9	KemiriStation– Solo Jebres Station	7,52 Km	7,12 Km	5,3%
10	Solo Jebres Station – Solo Balapan Station	2,14 Km	2,35 Km	9,8%
Average % Error				4,16%

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TABLE 4. Interval data logger test results

No.	Timestamp (X)	Timestamp (Y)	Difference = Y – X (s)
1	2021-03-08 01:02:00	2021-03-08 01:02:00	0
2	2021-03-08 01:03:00	2021-03-08 01:03:00	0
3	2021-03-08 01:03:59	2021-03-08 01:04:00	1
4	2021-03-08 01:05:00	2021-03-08 01:05:00	0
5	2021-03-08 01:06:00	2021-03-08 01:06:00	0
6	2021-03-08 01:06:59	2021-03-08 01:07:00	1
7	2021-03-08 01:08:00	2021-03-08 01:08:00	0
8	2021-03-08 01:09:00	2021-03-08 01:09:00	0
9	2021-03-08 01:09:59	2021-03-08 01:10:00	1
10	2021-03-08 01:11:00	2021-03-08 01:11:00	0
Average Difference			0.3

IV. CONCLUSION

Based on the results of the design, testing and analysis carried out on the PIDS, it can be concluded:

1. PIDS can display or convey information visually and audio to passengers in the form of train names and train station estimates on the P10 running text during the trip in real time.
2. The results obtained based on the test are the average difference in GPS is 8,185 m, the percentage of distance comparison error is 4.16%, and the average difference in logger data is 0.3 seconds. The power consumption required for the operation of the whole system is 90.875 Watts and the data consumption is 312Mb / day.

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