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Nomor: 762.9/II.3.AU/14.00/C/KET/XII/2022

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Judul Artikel	: Integrated Point of Sales and Snack Vending Machine based on Internet of Things for Self Service Scale Micro Enterprises
Nama Pemohon	: Arief Wisaksono / TEKNIK ELEKTRO
URL Sinta Pemohon	: https://sinta.kemdikbud.go.id/authors?q=arief+wisaksono
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sktp-20-12-2022 07_25_14-216587

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Design and Development of Parking Motor Parking Information System at Muhammadiyah University, Sidoarjo

To cite this article: Arief Wisaksono and Catur Aswar Ragil 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **874** 012015

Design and Development of Parking Motor Parking Information System at Muhammadiyah University, Sidoarjo

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Abstract. The problem that often occurs in high-rise motorbike parking lots is the lack of information on the availability of motorbike parking lots. Currently at Muhammadiyah University in Sidoarjo there is no information system in the motorbike parking lot so users are often forced to surround parking lots to find empty parking lots, in the face of problems this requires a good information system so that motorbike parking users can find out information on the availability of parking spaces. Through this research entitled the design of a motorbike parking information system in a multi-storey building, it is expected to make it easier for users to park at Muhammadiyah University in finding a parking space. This research is done by making a design simulation by utilizing Arduino module components, Ethernet shield modules & infrared obstacle sensors, the working principle of the system is the infrared obstacle sensor installed at the entrance and exit on each floor whose function is to provide data to the Arduino then Arduino processes the sensor by sending data to the database, the database is used to store data and sensor values in the database that will be displayed in the Web browser which will be displayed on the monitor installed on the ground floor to notify the driver of the empty parking slot so as to produce efficiency BBM and time efficiency.

1. Introduction

The parking lot is one of the vehicle stop facilities that must be available in a workplace, lecture center, mall, and others that have many vehicle users. There are also various types of parking lots, one of which is the parking lot in a multi-storey building, the parking area, especially motorcycle parking in this building, often makes it difficult for motorists to find an empty parking space so that it forces motorists to surround the parking lot to find a parking space which is still empty and this often makes the driver disappointed.[1][2]. Problems that occur when searching for parking slots can occur anywhere, one of them is at Muhammadiyah Sidoarjo University, motorcycle parking area in the form of a five-storey building is very difficult for motorcyclists when searching for parking slots because there is no definitive information system, using only a crossbar notification with one security to steer manually, this is very ineffective for users of motorcycle vehicles.[3] The globalization, technology is developing very fast along with the enormous human needs and the internet is a solution of current technological developments, all work can be overcome with internet technology and its supporting devices, internet of things is technology that uses the internet as a means to do something, the internet of things works by transferring data with networks without requiring interaction from human to human or from human to computer.[4] In its application IOT aims to facilitate human activities such as booking tickets online, Live Streaming, GPS Tracking, Remote sensors, Health Monitoring and so on by utilizing the internet. The communication data from IoT and API modules will be stored in the cloud server, which will be visualized by the application server to be used by the user who is the owner of each machine. So that users can monitor the activities with web applications.[5]

The above background, the writer has an idea by combining information systems on motorcycle parking availability with the internet, with the title "Design of building information systems for parking on multi-storey buildings in Muhammadiyah Sidoarjo University based on internet of things", with this title it is expected that all citizens of Muhammadiyah Sidoarjo University get information motorcycle parking space, before entering the building and it is hoped that motorists will no longer be confused in finding empty parking slots so as to produce fuel efficiency and time efficiency.[6][7]

2. Materials And Methods

2.1 Research Tools and Materials

The research tools and materials used to design the building of a motorbike parking information system based on internet of things .

The tools used in making this research are as follows:

1. Solder
2. Avo meter
3. Screwdriver +.
4. Peeled Pliers.

The materials used in making this thesis are as follows:

1. Arduino Mega 2560
2. Web Server.
3. Infrared sensors
4. Ethernet Shield Module
5. 0.75 cable.
6. Acrylic thick 2mm: 30 x 30 x 100 cm

2.2 System Analysis

2.2.1 Diagram Blok

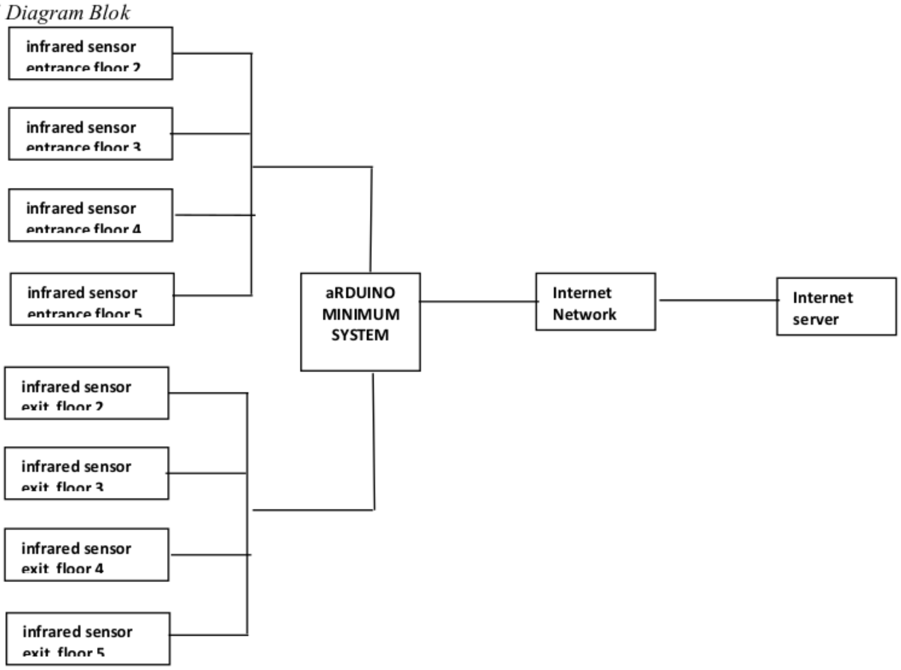

Figure 1 System Block Diagram

Based on the block diagram above, it is explained that the infrared sensor on each floor detects incoming and outgoing motorbikes. If an infrared sensor that is in the entry and exit stairs is detected, the sensor will send analog data that will be processed by the arduino minimum system with an up-down system counter, the results of data processing by the arduino minimum system will output the remaining parking slots on the web that will be displayed with an LCD monitor with arduino communication with the Ethernet shield. The design and manufacture of Internet Based Building Information Parking System of Things Based on the University of Muhammadiyah Sidoarjo includes software and hardware, including:

1. Arduino As a control or control center of all infrared sensors and outputs on analog data output.
2. Infrared sensor As a sensor to detect motorcycle vehicles.
3. Web As a process to display parking slot information from a data base.
4. LCD monitor as a display for parking slot information.
5. Data Base As data storage.

3. Results And Discussion

The results of this Final Project were applied in a miniature form using acrylic material with a width of 30cm x10cm x2 mm with a pole made of MS long drat 8 mm.

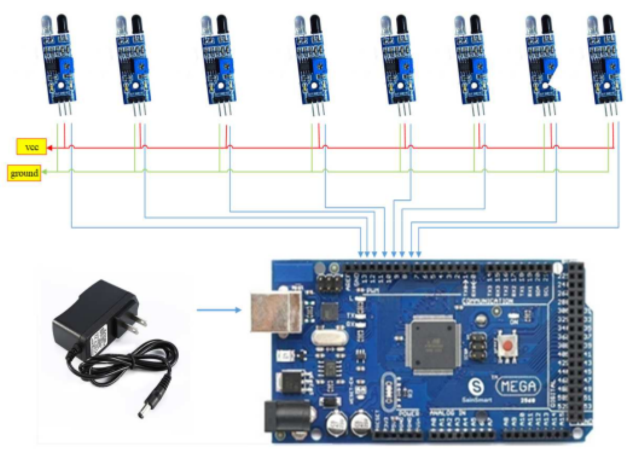

Figure 2. circuit diagram

And to find out the system is running well then testing is done in every part of the system, Testing every part of the system is carried out in order to know the principles and how the tool works that are in accordance with the plan or not. Retrieval of test data is carried out from the system every part. The tests are as follows:

1. Infrared Sensor Testing In

Table Infrared Sensor testing

trial-	Infrared Sensor In floor 2		Infrared Sensor In floor 3		Infrared Sensor In floor 4		Infrared Sensor In floor 5		Voltage Average		Standart Deviasi voltage		Deviasi	% accuracy
	measurement (V)	V (In)	measurement (V)	V (In)	measurement (V)	V (In)	measurement (V)	V (In)	measurement (V)	V (In)	measurement (V)	V (In)		
1	4,04	4,11	4,04	4,11	3,85	3,53	3,84	3,94	3,924	3,98	0,0118	0,0258	0,056	99,49
2	4,03	4,11	4,04	4,11	3,85	3,53	3,84	3,94	3,921	3,968	0,015	0,015	0,046	100
3	4,03	4,11	4,04	4,11	3,85	3,53	3,84	3,94	3,921	3,968	0,015	0,015	0,046	100
4	4,03	4,11	4,04	4,11	3,85	3,53	3,84	3,94	3,921	3,968	0,015	0,015	0,046	100
5	4,03	4,11	4,04	4,11	3,85	3,53	3,84	3,94	3,921	3,968	0,015	0,015	0,046	100

average =	3,922	3,97	0,0137	0,01736	0,04825	99

2. Infrared Sensor Testing out

Table Infrared Sensor testing

trial-	Infrared Sensor Out floor 2		Infrared Sensor Out floor 3		Infrared Sensor Out floor 4		Infrared Sensor Out floor 5		Voltage Average		Standart Deviasi voltage		Deviasi	% accuracy
	measurement (V)	V (In)	measurement (V)	V (In)	measurement (V)	V (In)	measurement (V)	V (In)	measurement (V)	V (In)	measurement (V)	V (In)		
1	4,08	4,11	3,89	3,9	3,84	3,84	3,81	3,9	3,924	3,98	0,0118	0,0258	0,056	99,49
2	4,08	4,11	3,89	3,9	3,84	3,84	3,81	3,8	3,921	3,968	0,015	0,015	0,046	100
3	4,08	4,11	3,89	3,9	3,84	3,84	3,81	3,8	3,921	3,968	0,015	0,015	0,046	100
4	4,08	4,11	3,89	3,9	3,84	3,84	3,81	3,8	3,921	3,968	0,015	0,015	0,046	100
5	4,08	4,11	3,89	3,9	3,84	3,84	3,81	3,8	3,921	3,968	0,015	0,015	0,046	100
				average =					3,922	3,97	0,0137	0,01736	0,04825	99

Based on the Infrared Sensor testing table, using calculations as much as five times the data collection. And also the sensor input voltage to compare the sensor reading results whether the sensor output voltage is the same as the sensor input voltage or not. Where is explained in the table written below the Infrared sensor reading that uses the Infrared Obstacle sensor with the difference made measuring the input voltage has a pretty good reading accuracy that is equal to 99.94% to 99.26% accuracy of the reading. With a deviation of 0.04 v this explains that the reading level of the reading is not too different from the input voltage. Where in the table above is the calculation formula as below.

Average calculation formula: $$\mu = \frac{x_1 + x_2 + x_3 \ldots + x_n}{n}$$

Standard deviation calculation formula: $$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \mu)}{n - 1}}$$

Deviasi formula:

$$Deviasi = |\ \mu^{Sensor\ Suhu} - \mu^{Alat\ Standar}\ |$$

Proportion Percentage Formula: $$\%\ Ketepatan = |1 - \left|\frac{Yn - Xn}{Xn}\right||\ \times 100\ \%$$

Information :	
μ = Average Value = Standard Deviation n = Amount of data	x_1 = Data 00-1 x_n = Data ke-n x_i = Data ke-i
Yn = Measurement results with a Volt meter Xn = Value read on the sensor output	

Calculation of Average Infrared Sensor Measurement

$$\mu = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{n}$$

$$= \frac{4{,}04 + 4{,}04 + 3{,}85 + 3{,}84 + 4{,}08 + 3{,}89 + 3{,}84 + 3{,}81}{5}$$

$$= 3{,}924$$

Calculation of Average V (in)

$$\mu = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{n}$$

$$= \frac{4{,}11 + 4{,}11 + 3{,}93 + 3{,}93 + 4{,}11 + 3{,}9 + 3{,}84 + 3{,}8}{5}$$

$$= 3{,}968$$

Calculation of Standard Deviation of Infrared Sensor measurements

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \mu)^2}{n-1}}$$

$= 0{,}011$

Calculation of Standard Deviation on V (in)

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (4{,}11-3{,}968)^2+(4{,}11-3{,}968)^2+(3{,}93-3{,}968)^2+(3{,}93-3{,}968)^2+(4{,}11-3{,}968)^2+(3{,}9-3{,}968)^2 +(3{,}84-3{,}968)^2+(3{,}81-3{,}968)^2}{5-1}}$$

$$\sigma = \sqrt{\frac{0{,}02+0{,}02+0+0+0+0{,}02+0+0}{4}}$$

$$\sigma = \sqrt{\frac{0{,}06}{4}}$$

$$\sigma = 0{,}015$$

a) Calculation of Deviation

$$Deviasi = |\,\mu^{V\,input} - \mu^{pengukuran}\,|$$

$$Deviasi = |0{,}015 - 0{,}010|$$

$$Deviasi = 0{,}05$$

b. Calculation of Percentage of Accuracy

$$\%\ accuracy = \left|1 - \left|\frac{Yn - Xn}{Xn}\right|\right| \times 100\%$$

$$\%\ accuracy = \left|1 - \left|\frac{3{,}968 - 3{,}964}{3{,}964}\right|\right| \times 100\ \%$$

$$\%\ accuracy = |1 - 0{,}00100908| \times 100\ \% = 99{,}89$$

1. Infrared Sensor Linearity Testing of distances

Tabel Infrared Sensor Linearity Testing of distances

No.	Testing	distances (cm)	With Object	Without Object	Vin
1	Infrared Sensor In floor 2	1 cm	0	4,04	4,11
		3 cm	0	4,03	4,11
		4 cm	0	4,04	4,11
		5 cm	0	4,03	4,11
		6 cm	4,04	4,04	4.11
2	Infrared Sensor In floor 3	1 cm	0	4,04	4,11

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No.	Testing	distances (cm)	With Object	Without Object	Vin
		3 cm	0	4,04	4,11
		4 cm	0	4,05	4,11
		5 cm	0	4,05	4,11
		6 cm	4,05	4,05	4.11
3	Infrared Sensor In floor 4	1 cm	0	3,85	3,93
		3 cm	0	3,85	3,93
		4 cm	0	3,86	3,93
		5 cm	0	3.85	3,93
		6 cm	3,85	3,85	3,93
4	Infrared Sensor In floor 5	1 cm	0	3,84	3,93
		3 cm	0	3,84	3,93
		4 cm	0	3,84	3,93
		5 cm	0	3.84	3,93
		6 cm	3,84	3,84	3,93
5	Infrared Sensor Out floor 2	1 cm	0	4,03	4,08
		3 cm	0	4,03	4,08
		4 cm	0	4,03	4,08
		5 cm	0	4,03	4,08
		6 cm	4,03	4,04	4.08
6	Infrared Sensor Out floor 3	1 cm	0	3,89	3,90
		3 cm	0	3,89	3,90
		4 cm	0	3,89	3,90
		5 cm	0	3.89	3,90
		6 cm	3,89	3,89	3,90
7	Infrared Sensor Out floor 4	1 cm	0	3,83	3,84
		3 cm	0	3,83	3,84
		4 cm	0	3,83	3,84
		5 cm	0	3.83	3,84
		6 cm	3,83	3,83	3,84
8	Infrared Sensor Out floor 5	1 cm	0	3,81	3,80
		3 cm	0	3,81	3,80
		4 cm	0	3,81	3,80
		5 cm	0	3.81	3,80
		6 cm	3,81	3,81	3,80

Note: From the results of the linear sensor infrared test against distance can be concluded that the sensor is linear between a distance of 5 cm - 6 cm, if there are objects in the range of 1 cm - 4 cm, the output voltage becomes 0 v and in the range of 5 cm - 6 cm the output voltage is linear

2. Ethernet Shield Module Connectivity Testing

	Connectivity Testing Modul Ethernet Shield dengan Device (Local Host)			
	Device (Lenovo B490)	Device (Asus X453 M)	Device (Compact CQ43)	Device (Lenovo B520)
Status Connectiing	Connectiing	Connectiing	Connectiing	Connectiing
Ip Address	192.168.137.41	192.168.137.67	192.168.137.130	192.168.137.99

Note: From the test results it can be concluded that the ethernet module can be used to connect arduino to the internet through different devices but the IP address must be reset because the ethernet shield module that is connected to arduino itself does not have a fixed IP address.

Testing Website Display

Tabel Testing Serial Monitor at Website

No.	Serial Monitor	Website Display	Information
1.	Connected Parking Lot parking available 2 = 0 Parking Lot parking available 3= 6 Parking Lot parking available 2 = 0 Parking Lot parking available 2 = 6 (Real Time)	Parking Lot parking available 2 = 0 Parking Lot parking available 3= 6 Parking Lot parking available 2 = 0 Parking Lot parking available 2 = 6 (Delay 3-5 detik)	There is a time difference between the monitoring results on the website and the serial monitor
2.	Connected Parking Lot parking available 2 = 2 Parking Lot parking available 3= 4 Parking Lot parking available 2 = 1 Parking Lot parking available 2 = 6 (Real Time)	Parking Lot parking available 2 = 2 Parking Lot parking available 3= 4 Parking Lot parking available 2 = 1 Parking Lot parking available 2 = 6 (Delay 3-5 detik)	There is a time difference between the monitoring results on the website and the serial monitor
3.	Connected Parking Lot parking available 2 = 0 Parking Lot parking available 3= 6 Parking Lot parking available 2 = 0 Parking Lot parking available 2 = 6 (Real Time)	Parking Lot parking available 2 = 0 Parking Lot parking available 3= 6 Parking Lot parking available 2 = 0 Parking Lot parking available 2 = 6 (Delay 3-5 detik)	There is a time difference between the monitoring results on the website and the serial monitor
4.	Connected Parking Lot parking available 2 = 7 Parking Lot parking available 3= 7 Parking Lot parking available 2 = 7 Parking Lot parking available 2 = 7 (Real Time)	Parking Lot parking available 2 = 7 Parking Lot parking available 3= 7 Parking Lot parking available 2 = 7 Parking Lot parking available Parking Lot parking available 2 = 7 (Delay 3-5 detik)	There is a time difference between the monitoring results on the website and the serial monitor

After testing and retrieval of data for several times, it can be concluded that the Design of Building Information Systems for Multi-storey Building Motorcycle Parking at IOT-based Muhammadiyah University can be concluded as follows:

1. Infrared sensor reading to detect motorcycle, with a comparison between input and measurement voltages with a volt meter at the output voltage. The accuracy of the sensor readings in two data retrieval successfully reads a range of 99.94%. So the sensor works well.

2. The Arduino Mega 2560 module with Ethernet Shield is used as the sender of data to a database that will be accessed by a web browser, where this module will be coded using the Arduino IDE software so that it can be used. In this experiment a smooth internet network is needed so that the process of transferring data to a database is expected to be faster.

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