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# MONITORING SYSTEM BASED IOT OF PARKING

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**ABSTRACT (10 PT, Bolt)**

Parking problems such as effectiveness, parking efficiency are parking problems that have occurred in manual parking systems. Therefore, it is necessary to have a well-structured parking system capable of offering various solutions to existing parking problems. One solution to building this system is to create a parking monitoring system based on IoT. The Parking System Design aims to design an IOT-based microcontroller that can inform and direct car drivers to an empty parking area and to determine the availability of parking slots, especially in large and multi-storey parking lots.. This design has several common parts that are used, namely NodeMCU ESP8266, IR Obstacle Sensor, LM2596, Servo Motor, Smartphone, Adapter. In this design, the distance on the sensor is less than 5cm, indicating that the parking slot is filled, while the servo motor will control the entrance and exit bars of each vehicle that wants to enter with a delay of 2 seconds. The smartphone will receive data from the sensor to display the number of filled vehicles and empty slots.

**Keyword : NodeMCU ESP8266, Sensor IR Obstacle, LM2596, Motor Servo, Smartphone, Adaptor**



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## 1. INTRODUCTION

Along with the rapid growth of motor bikes and cars, causing unbalanced parking conditions between the growth of motorized vehicles and the parking spaces that have been provided, this mismatch often makes it difficult for a driver to find a place to park his vehicle or simply to ensure that there is still or no parking space available in the parking area. A research study (Tsiaras, et al., 2015) shows that it takes motorists about eight minutes to find an empty parking slot. This difficulty finding a parking location results in congestion, wasting time and resources.The irregular position of the vehicle in the parking lot causes the space for each vehicle to not be filled according to its capacity. Apart from this, it is very ineffective because it takes a long time for the driver to find an existing parking space without certainty, it will also create congestion in the parking area due to the accumulation of queues of vehicles that still fill the road in the parking area.According to (Baratam, et al., 2016) and (Moses, et al., 2016) the solution to solving the problem of finding a parking location is the information provided about empty parking slots with Internet Of Things (IoT) technology and in real time through mobile application. The development of IoT-based technology that connects scattered devices to the control system, makes data transmission access times faster (Chauhan, et al., 2016). However, studies conducted in solving problems regarding parking have not been implemented and are still in concept planning. Therefore, information on the availability of parking spaces is very important for every driver who will park his vehicle to be appointed as a solution to this problem, namely by creating a parking system that not only counts the number of vehicles entering and leaving but also displays the location of a full parking lot. and empty. Information about empty parking lots can help motorists not to go around first to find an empty parking lot. With the Internet of Things (IoT) technology, smartphones can automatically control a system and it is also possible to give action to the system against events that occur in a controlled system in real time. This parking system is designed with a device consisting of obstacle infra red sensors, motorservo, NodeMCU microcontroller.

## 2. LETERATURE REVIEW

### 2.1. System
The system according to Winamo (2006) is "a set of components that work together to achieve certain goals. Tata Sutabri (2012) states that information is data that is processed or that has been clarified and interpreted for use in the decision-making process. Information processing systems or processing data from useless forms become useful for those who receive them. The value of information is related to decisions. If there is no choice or decision, information is not required.

### 2.2. Monitoring
Gentisya Tri Mardiani (2013) states that monitoring is a routine process of collecting data and measuring progress on program objectives. Monitor changes that focus on processes and outputs. Monitoring provides raw data to answer questions, while evaluation is to put the data so that it can be used and thus provide added value. Evaluation is where learning events, questions to answer, recommendations to make, suggesting improvements. But without monitoring, evaluation will have no basis, have no raw materials to work with and are limited to areas of speculation. Therefore, Monitoring and Evaluation must go hand in hand.

### 2.3. Parking
Dedy Indra Setiawan (2015) states that parking is the immovable state of a vehicle that is temporary because it is abandoned by the driver. Basically, the transportation system is divided into 3 main elements, namely vehicles, track infrastructure and terminals. Traffic is traveling to a destination and after reaching that place the vehicle needs a stop. The stopping place is then referred to as a parking space.

### 2.4. Internet of Things (IoT)
IoT is an archetype that aims to provide new ideas in the field of information and communication technology, in the IoT model "Everything" can be connected to the internet, so that information can be processed and disseminated quickly. Therefore, IoT plays an important role in the development of a smart city. (Misbahuddin et al, 2015).
There are three main components in IoT that must be fulfilled, among others:
1. Hardware consists of sensors, actuators and embedded communications hardware,
2. Midleware on storage and computing tools for data analysis and,
3. Easy to understand presentation visualization and interpretation tools that are widely accessible on different platforms and which can be designed for different applications.

### 2.5. NodeMCU ESP8266
NodeMCU is an open source IoT platform. This includes firmware running on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware based on the ESP-12 module. The term "NodeMCU" by default refers to firmware rather than dev devices. The firmware uses the Lua scripting language. It is based on the eLua project, and is built on the Espresso Non-OS SDK for the ESP8266. It uses a lot of open source projects, such as lua-cjson, and spiffs.

### 2.6. Sensor InfraRed Obstacle
The Infrared Obstacle Sensor is a module consisting of infrared and a photodiode which functions as a detector for obstacles or objects in front of it. The following are the components of the module:
1. Its main components consist of IR and IR receiver / phototransistor.
2. When power-up, the IR emitter will emit visible infrared light.
3. The light is then reflected by the object in front of it. This reflected light is then received by the IR receiver.
4. There is an Op-Amp LM363 which functions as a comparator between the IR receiver resistance and the sensitivity regulator trimpot resistance.
5. The output of this op-amp is also connected to the “OUT” pin which is connected to the Arduino.

### 2.7. Arduino Software (IDE)
IDE (Integrated Development Environment) is a software used to develop microcontroller applications starting from writing source programs, compiling, uploading compilation results and testing in serial

terminals. Arduino uses its own programming language that resembles the C language. The Arduino programming language (Sketch) has made changes to make it easier for beginners to do programming from the original language. Before being sold to the market, the Arduino microcontroller IC has implanted a program called Bootlader which functions as an intermediary between the Arduino compiler and the microcontroller. The Arduino IDE is made from the JAVA programming language. The Arduino IDE is also equipped with a C / C ++ library which is commonly called Wiring which makes input and output operations easier. Arduino IDE was developed from software

2.8. Motor Servo

The servo motor is a motor with a closed feedback system where the position of the motor will be informed back to the control circuit in the servo motor. This motor consists of a motor, a series of gears, a potentiometer and a control circuit. Potentiometer serves to determine the angular limit of the servo rotation. While the angle of the servo motor axis is adjusted based on the pulse width sent through the signal leg of the motor cable.

2.9. Methodology

Block Diagram

The block diagram system serves to describe the system with an image so that the system to be designed looks real and not from mere engineering. The following is a block diagram system designed for this project:

In designing an IoT-based parking monitoring system, it requires a 12V DC power supply to activate the ESP8266 NodeMCU module, Obstacle IR sensor, LM2596, and servo motor. The IR Obstacle sensor has LOW logic if a vehicle is detected then the IR Obstacle sensor then the IR Obstacle sensor sends HIGH or LOW detection results and is received by NodeMCU ESP8266 processes the sensor detection results, if the sensor data is LOW then NodeMCU ESP8266 counts incoming vehicles, if the sensor data is HIGH then no vehicles enter, then the calculated data is processed into parking space information. The parking information results are displayed via the Smartphone.

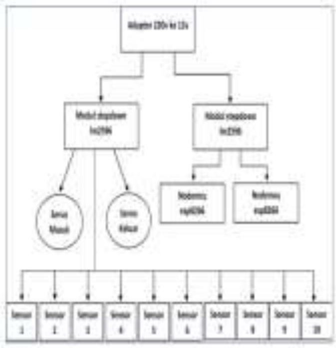

Fig 1. Block Diagram

The following is a discussion in more specific block diagram division and work system tools:

1. Power Supply adapter that works with a voltage of 220V to 12V and will send voltage to each component.
2. ESP266 NodeMCU module which has a WiFi module and is connected to the internet using a WiFi network. This module functions to connect the simulator to the internet so that the device can communicate with a smartphone as well as the controlling brain of all components in charge of receiving sensor data, processing sensor data, sending data results to be displayed on a smartphone and controlling the parking doorstop.
3. Smartphone as parking information display sent by NodeMCU ESP8266.

System Planning

Fig 2. Smart Parking System Design

From Capture 3.2 above, it can be explained as follows:
1. LM2596 as a voltage drop from 5V will send current to NodeMCU ESP 8266.
2. The ESP8266 NodeMCU reduces the current by 3.3V as the controller and system driver and divides the current to the Obstacle IR sensor and servo motor.
3. WiFi module connects the device to the internet.
4. The Arduino IDE reads the user id and password from the hotspot or WiFi being used.
5. The parking plan output will be displayed via a smartphone in the form of an LED indicator on the IR Obstacle sensor that has been programmed with the Arduino IDE.
6. After that the output data is sent to the database on the Blynk application on the smartphone via the internet.
7. The smartphone is connected to the Blynk application via the internet.

Prototype Design
In designing this prototype using the main material, namely plywood. Where the road design itself is made of plywood where the top layer is a parking prototype consisting of 10 parking slots along with obstacle ir sensors, vehicle lanes, door latches, servo motors and the left side of the parking prototype are NodeMCU and LM2596.
The IOT-Based Parking Monitoring System Design will explain the working principles of the tool as follows:
1. The system operates at an input voltage of 220V which is lowered to 12V and rectified so that it can produce a constant voltage of 12V DC-5V DC from the LM2596 which lowers the voltage so that the current remains stable.
2. The controller used is the ESP8266 NodeMCU module which has been integrated by WiFi.
3. The component used is the servo motor, as a tool to open and close the parking door latches in and out, the current source of the servo motor is processed from the LM2596 with a voltage of 5V which will flow through the 3.3V NodeMCU ESP8266 which already has its own regulator.
4. IR Obstacle sensor is used as a detector for every vehicle with a distance of less than 5cm and will send data to the Blynki application as a viewer with the LED on.

Network Diagram
1.NodeMCU ESP8266 Network Diagram

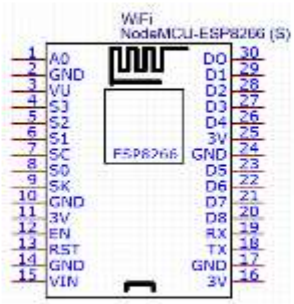


Fig 3. NodeMCU Network Diagram

In the NodeMCU circuit using the NodeMCU module there are 30 pins consisting of 10 digital pins and 1 analog pin. For digital pins consist of D0, D1, D2, D3, D4, D5, D6, D7 and D8. While the analog pin consists of A0.

2.Servo Motor Network Diagram

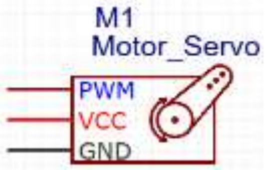

Fig 4. Servo Motor Circuit

In the circuit schematic from Servo Motor to NodeMCU can be explained as follows:
1. The Vcc pin is connected to the 5V supply voltage on the NodeMCU.
2. GND pin is connected to GND on NodeMCU
3. The PWM pins are connected to D6 and D7 pins on the NodeMCU.

3.Diagram Rangkaian Sensor IR Obstacle

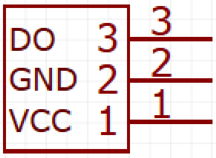

Fig 5. IR Obstacle Sensor Circuit

In the circuit scheme from the IR Obstacle Sensor to NodeMCU it can be explained as follows:
1. Pin Out is connected to Pins D1, D2, D3, D4, D5, D6, D7 on NodeMCU.
2. The GND pin is connected to the OUT pin on the LM2596.
3. The Vcc pin is connected to the OUT + pin on the LM2596.

4.Network Diagram LM2596

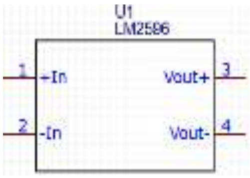

Fig 6. LM2596 circuit

In the circuit schematic from the LM2596 voltage to the IR Obstacle Sensor and the 220V to 12V Adapter can be explained as follows:
1. The IN pin is connected to the cable from the 220V V-adapter which has been downgraded to 12V. The IN + pin is connected to the cable from the V + adapter.
2. Pin OUT- connects to GND on the Obstacle IR Sensor. Pin OUT + is connected to Vcc on the Obstacle Sensor.

5. 220V to 12V Adapter Circuit Diagram

Fig 7. 22V to 12V Adapter Circuit

The 22V to 12V adapter circuit on the LM2596 can be explained as follows:

1. The AC pin is connected to the mains power supply.
2. Pin V + is connected to IN- Obstacle IR Sensor.
Pin V- is connected to the IN + IR Obstacle Sensor.

6. Entire Network

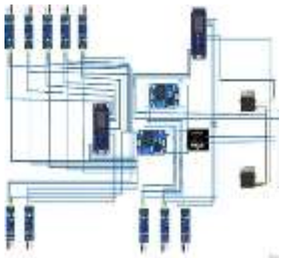

Fig 8. Overall Circuit

The electronic part of the circuit used in the parking monitoring system is the main component of the parking system.
1. The main voltage by the adapter is 12V which will then be received by the StepDown LM2596. The function of the StepDown LM2596 is to reduce the voltage with the aim that the supply given to each component is stable without a shortage of voltage. The voltage drop from the adapter will be 5V. In the circuit schematic of the LM2596 voltage to the Obstacle IR Sensor and the 220V to 12V Adapter, it can be explained as follows: The IN-pin is connected to the cable from the 220V V-adapter which has been lowered to 12V. The IN + pin is connected to the cable from the V + adapter. Pin OUT- connects to GND on the Sensor Obstacle. Pin OUT + is connected to Vcc on the Obstacle Sensor.
2. NodeMCU ESP8266 has 30 pins consisting of 10 digital pins and 1 analog pin. The components connected to the ESP8266 NodeMCU in a series are pins D1, D2, D3, D4, D5, D6, D7, GNG, Vin. The IR ObstacleI sensor component detects objects in vehicles when parking. In the circuit scheme from the IR Obstacle Sensor to NodeMCU it can be explained as follows: Pin Out is connected to Pins D1, D2, D3, D4, D5, D6, D7 on NodeMCU. GND pin is connected to Pin OUT- on LM2596. The Vcc pin is connected to the OUT + pin on the LM2596.
3. In the circuit schematic from the Servo Motor to the NodeMCU it can be explained as follows: The Vcc pin is connected to the 5V supply voltage on the NodeMCU. GND pin is connected to GND on NodeMCU. PWM pin is connected to pin D6 and D7 on NodeMCU.

## 3. RESULTS AND DISCUSSION

3.1. Testing

1. Testing the power supply voltage and LM2596

IOT-based Parking Monitoring Information System Simulator requires a voltage of 5V DC to operate with a stable current. The power supply adapter is used to stabilize the 220V AC voltage to 12V DC. In accordance with the output available on the 12V DC adapter, the voltage test is not carried out on the power supply.

2. Testing the IR Obstacle Sensor on Parking Slot Detection

To carry out this test, there are several conditions that must be prepared, namely whether the parking slot is empty or not. When the parking slot is empty it means that the object reading by the sensor is not there as far as 5cm, whereas if the parking slot is filled it means that the sensor detects an object from a distance of 3cm. When power-up, the IR transmitter will emit visible infrared light and then the light is reflected by the object in front of it, the reflected light is then received by the IR phototransistor. When the IR phototransistor is exposed to infrared light due to the reflection of the object, it produces an output with LOW logic.

Table 1. The Value of the IR Obstacle Sensor Measurement Results on the object

| No. | Sensor Reading | Voltage | Description |
|---|---|---|---|
| 1 | HIGH | 0 Volt | When there is an object |
| 2 | LOW | 5 Volt | When there are no objects |

Fig 9. Testing the IR Obstacle Sensor

The picture below illustrates the design or layout of the parking slot display with the LED that lights up if the vehicle fills each parking slot. When the object has been detected through the IR Obstacle sensor in the parking slot and the LED indicator lights up, the Smartphone as Output will be on the smartphone via the Blynk application. Meanwhile, if you tell that the parking slot has been filled, it is marked by a led that lights up the parking slot is not filled, then the LED attribute on Blynk does not light up as shown below.

Fig 10. Display of a filled parking slot

Table 2. Testing of the IR Obstacle Sensor in the parking slot

| ***Slots -10*** | **Keadaan** | **Smartphone Display** | **Description** |
|---|---|---|---|
| 1 | Filled<br>Empty | LED = ON<br>LED= OFF | Work well |
| 2 | Filled<br>Empty | LED = ON<br>LED= OFF | Work well |
| 3 | Filled<br>Empty | LED =ON<br>LED=OFF | Work well |
| 4 | Filled<br>Empty | LED =ON<br>LED=OFF | Work well |
| 5 | Filled<br>Empty | LED =ON<br>LED=OFF | Work well |
| 6 | Filled<br>Empty | LED =ON<br>LED=OFF | Work well |
| 7 | Filled<br>Empty | LED =ON<br>LED=OFF | Work well |
| 8 | Filled<br>Empty | LED =ON<br>LED=OFF | Work well |
| 9 | Filled<br>Empty | LED =ON<br>LED=OFF | Work well |
| 10 | Filled<br>Empty | LED =ON<br>LED=OFF | Work well |

3.Testing of open and closed door bars when a car passes
The servo motor as a driver will open the parking bar when the car is approaching and the sensor will detect when it wants to enter the parking lot so that the bar will lift up so that the car can park and immediately the bar will close again.

Table 3. Testing of the IR Obstacle Sensor on the latch

| Cross | State | Cross Condition | Description |
|---|---|---|---|
| Sensor On | There is A Car | Open | Work well |
| Sensor Off | Empety | Closed | Work well |

3.2. Result
From the results of the design that has been done, a detector for the availability of a parking slot is found in the miniature parking area as shown below:

Fig 10. Parking Simulation

The dimensions for the overall size of the parking simulation are 55x47cm, each slot is 8x3cm, consisting of an entrance and exit, each measuring 6x4cm, and for latches measuring 9cm wide and 3cm high from the surface.
The position of the IR Obstacle sensor is placed in front of each parking slot with the total sensor in accordance with the number of parking slots, while the 2 IR Obstacle sensors are placed where the vehicle has not passed the latch to detect the vehicle that will enter the parking lot.
The following is a miniature car used in the tool as shown below:

Fig 11. Car Miniature

The final display on the smartphone will look like the image below. When all parking slots are fully filled by the IR Obstacle sensor readings on the system, the data will be received on the smartphone so that the parking lot plan will give a warning in the form of a voice notification that the parking lot is full. The warning will disappear if a vehicle leaves the parking slot.


Fig 12. Full view of the parking lot

The picture above shows that the data notification to Blynk indicates the parking slot is full. When the sensor in the parking lot has detected all parking slots, the data will be received by Blynk and display a voice.

Pros and Cons

From the test results it can be said that there are advantages of the system

This is the hardware or components used are designed in such a way with a function that is able to detect empty parking lots and it is easier for users to find empty parking lots. Utilization of the internet signal with the system will catch the signal to the driver and will be connected only via WiFi. While the drawback of this tool is that the delivery of information to the smartphone experiences a delay or delay which is influenced by the quality of the existing network in the area of smartphone users. The sensor used is very sensitive to light, so it detects objects as a result of light rays.

## 4. CONCLUSION

1. The system successfully detects the vehicle and the latch will be opened by the servo motor and the Blynk App displays the parking conditions.
2. Failed commands or notifications are often caused by slow internet networks.
3. This system was built to make it easier for motorists who want to find a safe parking space with an efficient time so that the parking location can be directly monitored by the condition of the parking capacity that has been used.
4. The system will send a notification to the Blynk Application when the parking slot is full.

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