

# An internet of things-based touchless parking system using ESP32-CAM

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## ABSTRACT

As technology continues to advance, governments around the world have implemented health protocols to minimize direct contact between individuals and objects, in response to the ongoing COVID-19 outbreak. To address this need, a touchless parking portal was designed using a microcontroller-based and internet of things (IoT) -based system, with the Arduino UNO microcontroller device serving as the core component. The system employs an ultrasonic sensor HC-SR04 and passive infrared (PIR) to detect vehicles as they arrive at the portal area, in addition to requiring an ESP32-CAM camera, servo motor, light-emitting diode (LED), I2C 16x2 liquid crystal display (LCD), push button, universal serial bus (USB) to transistor-transistor logic (TTL) converter, power supply, and portal bar. The system builder software was developed using Arduino integrated development environment (IDE), Android, and Blynk. The authors conducted thorough testing and analysis of the system, concluding that its overall performance reaches 100%. Nevertheless, despite the extensive experimentation conducted, there remains a possibility that certain factors could still affect the results. Therefore, caution is advised when interpreting the outcomes of this experiment.

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## 1. INTRODUCTION

The spread of the COVID-19 virus in the current era of globalization is increasingly widespread and continues to increase every day by hitting various countries around the world for more than a year [1]. COVID-19 is a respiratory disease caused by a virus (SARSCoV-2) that can cause respiratory infections, coughs, severe pneumonia, and even death. In breaking or reducing the spread of the virus, the government has established health protocols to minimize touching or direct contact between humans and objects around them in daily life. One of them is the use of a touchless automatic parking portal. That's why we designed a microcontroller and internet of things (IoT)-based touchless parking portal design.

The significance of the touchless parking portal design lies in its ability to address the pressing need to minimize direct contact between people and objects in public areas, such as parking lots [2]. This project is crucial in the fight against the spread of COVID-19, especially in highly frequented locations. The

motivation behind the development of this tool is to provide a touchless solution that helps to curb the transmission of the virus. Additionally, it serves to enhance the safety and security of parked vehicles by capturing photos of motorists as they exit the parking lot. The innovative design and efficient functionality of this tool makes it a valuable addition to the current public health measures put in place by the government.

In order to address this issue, a number of researchers have employed various sensors such as radio frequency identification (RFID) [2], [3], closed-circuit television (CCTV) [4], ultrasonic sensors [5]-[7], and passive infrared (PIR) sensors [8]-[10]. However, these sensors operate independently and are not integrated to compensate for each other's shortcomings. As a result, this study proposes a method that combines all of these sensors to create a more effective parking system. Equipped with a PIR sensor to detect when a human hand is approaching, the sensor responds and opens the portal, but if other than humans bring the hand closer, the sensor does not respond and the portal does not open. At the exit, it is equipped with 2 cameras to capture photos of motorists to minimize crime or theft [11], [12].

## 2. RESEARCH METHOD

The tools used as a support to design and build a no-touch parking portal based on a microcontroller and IoT include laptop, power supply, soldering iron, lead suction, cutting pliers, screwdriver and saw. While the materials needed are Arduino Uno R3, PIR sensor, ultrasonic sensor HC-SR04, green and red light-emitting diodes (LEDs), 16x2 LCD, servo motor, ESP32 CAM, FTDI FT232RL, push button, Resistors 200 and 10k ohms, jumper cables, glue, tin, tape, plywood, cardboard and breadboard. The research procedure carried out in designing a no-touch parking portal based on a microcontroller and IoT is divided into several stages: preparation, design, manufacturing, testing, and data analysis [13]-[15]. The parking portal is designed to be a no-touch system based on a microcontroller and IoT. A literature study was conducted to gather information on similar designs before proceeding to the design stage [4], [16].

The mechanism for the entrance portal is shown in the entrance portal block diagram in Figure 1 and prototype in Figure 2. The design stage of the system included the determination of the method by which the system would function when a driver enters or exits the portal. Upon entering the portal, the driver is required to bring their hand close to a PIR sensor and an ultrasonic 1 sensor [5]. If both sensors detect movement and an obstacle, respectively, the Arduino Uno R3 processor will turn on a green LED, display the message "Please Enter" on a 16x2 LCD screen, and instruct a servo motor to open the entrance portal. Once the vehicle blocks the ultrasonic sensor 2, the servo motor will close the entrance gate again [6], [7]. If only the PIR sensor detects movement, the processor will turn on a red LED and display the message "Close your hands" on the LCD screen. If only the ultrasonic 1 sensor detects an obstacle, the processor will turn on the red LED and display the message "Not Human" on the LCD screen.

Figure 3 illustrates the process of image capture processing. Two ESP32 CAM devices connected to Wi-Fi and controlled through Blynk software capture front and side driver images for security and surveillance purposes. The high-quality images and wireless connectivity enable real-time monitoring and recording. Blynk software allows easy customization of image capture parameters, optimizing quality and storage efficiency. In summary, ESP32 CAM devices with Blynk software provide an efficient and effective visual information capture solution.

The manufacturing stage is divided into three stages, the first is the mechanical manufacturing stage, the second is the hardware manufacturing stage, and the third is the software manufacturing stage. A push button schematic circuit, an LED schematic circuit, and a voltage common collector (VCC) and ground (GND) schematic terminal circuit were made using EasyEDA software at this stage to create an electronic circuit. After the circuit was created, the process of connecting or wiring each component to the Arduino Uno R3 microcontroller was completed [17]. The hardware was manufactured by printing the schematic circuits on printed circuit board (PCB), creating line layouts and component layouts, and assembling and installing components on the PCB circuits [18], [19].

To determine the performance of the tool well, the following tests will be conducted: testing the response of the components, testing the response of the ESP32-CAM based on WiFi signal strength, measuring the delay in photo capture, measuring the distance of the ESP32-CAM with WiFi, and measuring the angle tilt of the PIR sensor. All software and hardware devices are assembled for these tests [20]-[22]. Data analysis involves collecting data to determine how well the performance of the software made for this project can run properly. Testing is conducted using a PIR sensor to detect human movement, an ultrasonic sensor 1 to detect hand obstructions at the entrance portal, a green LED to display visualizations, an LCD 16x2 to display the text "Please Enter", and a servo 1 to open and close the entrance portal. The testing process begins by activating the PIR sensor which will detect human movement. If detected, the ultrasonic sensor 1 will be activated to detect hand obstructions at the entrance portal, then the green LED will light up and the LCD 16x2 will display the text "Please Enter". Next, the servo 1 will rotate 90 degrees to open the

entrance portal. After the human passes through the entrance portal, the ultrasonic sensor 2 will be activated to detect obstructions on the inside of the entrance portal. If an obstruction is detected, the servo 1 will rotate 90 degrees to close the entrance portal. This process is repeated 10 times to measure the system's success rate [23], [24].

For the second test, data on the influence of WiFi signal strength on the response of the devices, namely the ESP32-CAM and Blynk, is obtained. Blynk, as an IoT, can work well and efficiently with the WiFi signal strength received by the ESP32-CAM [25]. Both tests are conducted in order to obtain information about the characteristics of the tools being used, and the purpose of data analysis is to extract this information. The percentage of success and errors of the compiled tools can be calculated using (1) and (2) [26], [27].

$$\% \text{ Error} = \frac{\text{Amount of Error}}{\text{Amount of Test}} \times 100\% \quad (1)$$

$$\% \text{ Success} = 100\% - \% \text{ Error} \quad (2)$$

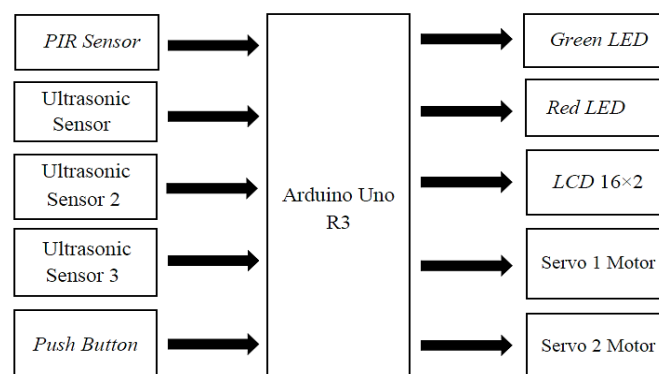


Figure 1. Block diagram of portal

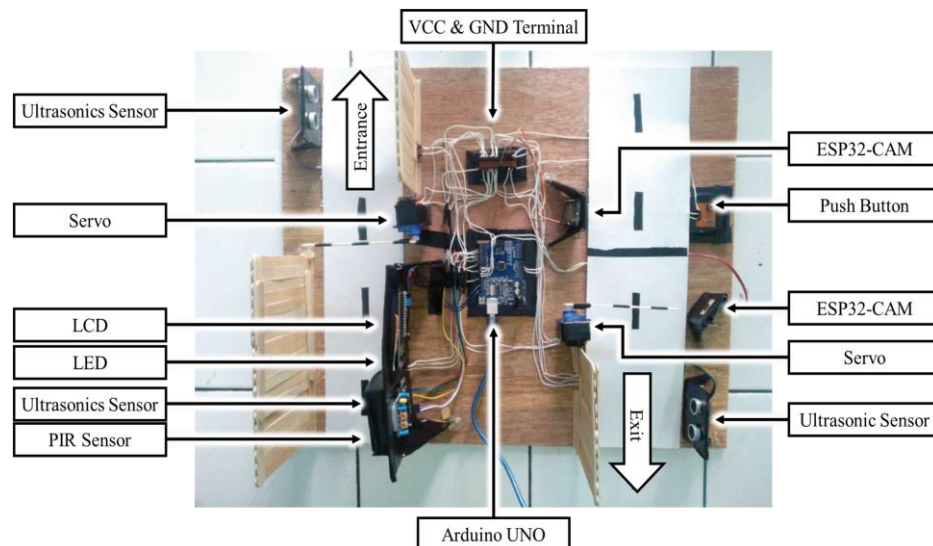


Figure 2. Portal prototype



Figure 3. Block diagram of image capture

### 3. RESULTS AND DISCUSSION

The entire system is tested under two conditions: entering the portal and exiting the portal. A small box representing a vehicle is used for the test simulation, with a 1x3 cm paper written with a license plate number and a 4x6 photo of a driver's face attached to the side. The tests are conducted by hand and data is taken during each condition through ten experiments. Table 1 shows the details of the test prototype, including the PIR sensor detecting movement (P), the ultrasonic sensor 1 detecting hand obstructions at the entrance portal (U1), the green LED lighting up (LE), the LCD 16x2 displaying the text "Please Enter" (LC), the servo 1 rotating 90 degrees to open the entrance portal (SB), the ultrasonic sensor 2 detecting obstructions on the inside of the entrance portal (U2), and the servo 1 rotating 90 degrees to close the entrance portal (ST). Based on the test data, the success percentage is calculated using (2).

Table 1. Simulation results of entering portal

Number of test	P	U1	LE	LC	SB	U2	ST	Results
1	✓	✓	✓	✓	✓	✓	✓	Success
2	✓	✓	✓	✓	✓	✓	✓	Success
3	✓	✓	✓	✓	✓	✓	✓	Success
4	✓	✓	✓	✓	✓	✓	✓	Success
5	✓	✓	✓	✓	✓	✓	✓	Success
6	✓	✓	✓	✓	✓	✓	✓	Success
7	✓	✓	✓	✓	✓	✓	✓	Success
8	✓	✓	✓	✓	✓	✓	✓	Success
9	✓	✓	✓	✓	✓	✓	✓	Success
10	✓	✓	✓	✓	✓	✓	✓	Success

Table 2 shows the details for the test involving exiting the portal. Pictures of the front of the vehicle and the clear license plate are taken by the ESP32 CAM 1 (C1), pictures of the clear face are taken by the ESP32 CAM 2 (C2), the push button is pressed (PB), the exit portal is opened by the servo 2 turning 90 degrees (SB), obstructions on the inside of the exit portal are detected by the ultrasonic sensor 3 (S3), and the exit portal is closed by the servo 2 turning 90 degrees (ST) during the test involving exiting the portal. The success percentage is calculated using the (2) based on the test data.

Table 2. Simulation results of exit the portal

Number of test	C1	C2	PB	SB	S3	ST	Results
1	✓	✓	✓	✓	✓	✓	Success
2	✓	✓	✓	✓	✓	✓	Success
3	✓	✓	✓	✓	✓	✓	Success
4	✓	✓	✓	✓	✓	✓	Success
5	✓	✓	✓	✓	✓	✓	Success
6	✓	✓	✓	✓	✓	✓	Success
7	✓	✓	✓	✓	✓	✓	Success
8	✓	✓	✓	✓	✓	✓	Success
9	✓	✓	✓	✓	✓	✓	Success
10	✓	✓	✓	✓	✓	✓	Success

Testing of the component performance response on the tool is carried out, and it is found to work well with an error percentage of 0% and a success percentage of 100% at both the login and exit portals. An approaching object at a distance of more than 3 cm is detected by the PIR and ultrasonic sensors at the entrance. The red LED lights up and the words "Close your hands" are displayed on the LCD. If the object brings their hand closer, the PIR and ultrasonic sensors will respond and the portal will automatically open, with the words "Please Enter" displayed on the LCD. The ultrasonic sensor will detect if there is an object approaching after going through the portal, causing the portal door to close again. All components work fine, resulting in an error percentage of 0%.

Testing of the ESP32-CAM response based on WiFi signal strength is carried out, and it is found to work well with an error percentage of 0% and a success percentage of 100%. The ESP32 camera is able to capture images well when the WiFi connection is stable, and the processing speed for capturing images with cameras 1 and 2 is fairly fast at 7-44 ms. This allows for the successful capture of an image of an object with

an error percentage of 0%. Testing of the ESP32-CAM response delay based on WiFi signal strength is also conducted, and it is found to work well with an error percentage of 0% and a success percentage of 100%. The ESP32 camera is able to capture images with a not-so-large delay of 0.65-14.25 s, resulting in an error percentage of 0% when capturing an image of an object. Testing of the ESP32-CAM distance with WiFi through 20 trials shows that the maximum distance at which the ESP32-CAM can still be connected to WiFi is 19 meters. At a distance of 20 meters, it cannot be connected, so the ESP-CAM can still be connected by WiFi within a distance of 1-19 meters. The slope angle on the PIR sensor is measured, and it is found that the angle of inclination at which the PIR sensor can detect objects is 10-60° from the center point to the right, left, up, and down when using the minimum sensitivity of 2 meters from the PIR sensor. Beyond a 60° angle from the center point, the PIR sensor is unable to detect objects.

#### 4. CONCLUSION

The response performance of the components on the tool has been tested and it has been found to be successful with an error percentage of 0% and a success percentage of 100% at both the login and exit portals. The ultrasonic sensor detects if there is an object approaching and the portal door closes again after the object passes through the portal. The ESP32 camera is able to capture images well when the WiFi connection is stable, with the processing speed for capturing images with cameras 1 and 2 being fairly fast at 7-44 ms. This enables the camera to capture an image of an object with an error percentage of 0%. The ESP32 camera can also capture images with a not-so-large delay of 0.65-14.25 s when the WiFi connection is stable, resulting in an error percentage of 0% when capturing an image of an object. The angle of inclination at which the PIR sensor is able to detect objects is 10-60° from the center point to the right, left, up, and down when using the minimum sensitivity of 2 meters from the PIR sensor. The PIR sensor is unable to detect objects beyond a 60° angle from the center point. The Blynk software is used as an IoT device for the ESP32-CAM control system which is heavily influenced by the strength of the WiFi signal. The software performance from the design of a no-touch parking portal based on a microcontroller and IoT can run well and effectively as a chain breaker for the spread of the COVID-19 virus by minimizing direct contact with surrounding objects in order to avoid exposure to the virus. The percentage of design success was reached in 10 trials, resulting in 100%.




#### REFERENCES

- [1] M. Fajar and W. Wahyudi, "Modeling of COVID-19 epidemic growth curve in Indonesia," *Jurnal Matematika MANTIK*, vol. 7, no. 1, pp. 67–73, May 2021, doi: 10.15642/mantik.2021.7.1.67-73.
- [2] M. S. Mazlan, I. R. A. Hamid, and H. Kamaludin, "Radio frequency identification (RFID) based car parking system," *International Journal on Informatics Visualization*, vol. 2, no. 4–2, pp. 318–322, Sep. 2018, doi: 10.30630/ijov.2.4-2.173.
- [3] S. Widodo, M. M. Amin, A. Sutrisman, E. Cofriyanti, and R. M. Puji, "Implementation of parking portal door security system using RFID and password based on microcontrollers in sriwijaya state polytechnic," *Journal of Physics: Conference Series*, vol. 1500, no. 1, p. 012114, Apr. 2020, doi: 10.1088/1742-6596/1500/1/012114.
- [4] M. Fraifer and M. Fernstrom, "Smart car parking system prototype utilizing CCTV nodes: a proof of concept prototype of a novel approach towards IoT-concept based smart parking," in *2016 IEEE 3rd World Forum on Internet of Things, WF-IoT 2016*, Dec. 2017, pp. 649–654, doi: 10.1109/WF-IoT.2016.7845458.
- [5] D. Sonker, V. Khatri, Ranjeeta, and A. Yadav, "Smart door using ultrasonic sensors," *International Journal of Advanced Research in Science, Communication and Technology*, pp. 499–501, Jun. 2021, doi: 10.48175/ijarsct-1429.
- [6] P. Ilampiray, K. Deepak, M. G. D. Santhosh, and S. Kishore, "Retraction: automated railway gate control system using Arduino and ultrasonic sensors," *Journal of Physics: Conference Series*, vol. 1916, no. 1, p. 012081, May 2021, doi: 10.1088/1742-6596/1916/1/012081.
- [7] P. Divya, N. Bhavana, and M. George, "Arduino based obstacle detecting system," *SSRN Electronic Journal*, 2020, doi: 10.2139/ssrn.3621950.
- [8] Y. W. Bai, Z. H. Li, and Z. L. Xie, "Enhancement of the complement of an embedded surveillance system with PIR sensors and ultrasonic sensors," in *Proceedings of the International Symposium on Consumer Electronics, ISCE*, Jun. 2010, pp. 1–6, doi: 10.1109/ISCE.2010.5522729.
- [9] Y. W. Bai, C. C. Cheng, and Z. L. Xie, "Use of ultrasonic signal coding and PIR sensors to enhance the sensing reliability of an embedded surveillance system," in *SysCon 2013 - 7th Annual IEEE International Systems Conference, Proceedings*, Apr. 2013, pp. 287–291, doi: 10.1109/SysCon.2013.6549895.
- [10] R. Handayani, "Design of pear sensor-based automatic doors (Passive Infra Red) at the Unpab faculty of engineering office (in Bahasa)," *Jurnal Teknik Mesin, Industri, Elektro Dan Informatika*, vol. 1, no. 2, pp. 23–29, Jun. 2022, doi: 10.55606/jtmei.v1i2.475.
- [11] Andreas, C. R. Aldawira, H. W. Putra, N. Hanafiah, S. Surjarwo, and A. Wibisurya, "Door security system for home monitoring based on Esp32," *Procedia Computer Science*, vol. 157, pp. 673–682, 2019, doi: 10.1016/j.procs.2019.08.218.
- [12] U. Sanikommu, "Pir sensor based security system," *Annals of Robotics and Automation*, pp. 022–024, Dec. 2020, doi: 10.17352/ara.000006.
- [13] Andie, F. Hafidh, and F. Rahmadani, "Web based smart parking: IoT microcontroller studies," *Journal of Physics: Conference Series*, vol. 1175, no. 1, p. 012056, Mar. 2019, doi: 10.1088/1742-6596/1175/1/012056.
- [14] V. A. Kusuma, M. I. A. Putra, and S. S. Suprpto, "Stock monitoring system and beverage sales on internet of things (IoT)-based vending machines using Google Sheets and Kodular (in Bahasa)," *Jurnal Sistim Informasi dan Teknologi*, pp. 94–98, Aug. 2022, doi: 10.37034/jsisfotek.v4i3.136.




- [15] A. E. Hamza *et al.*, "Design and implement WSN/IoT smart parking management system using microcontroller," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 10, no. 3, pp. 3108–3115, Jun. 2020, doi: 10.11591/ijece.v10i3.pp3108-3115.
- [16] D. Amalia, R. Hadiansyah, and V. Septiani, "Smart parking IoT based: design and prototype," *JMKSP (Jurnal Manajemen, Kepemimpinan, dan Supervisi Pendidikan)*, vol. 7, no. 1, p. 67, Jan. 2022, doi: 10.31851/jmksp.v7i1.6677.
- [17] A. James, A. Seth, and S. C. Mukhopadhyay, "Programming Arduino for IoT system," in *Smart Sensors, Measurement and Instrumentation*, vol. 41, 2022, pp. 81–104, doi: 10.1007/978-3-030-85863-6\_5.
- [18] T. D. Saputra and Z. Budiarto, "Design and build an IoT-based automatic sluice system (in Bahasa)," *Joutica : Journal of Informatic Unisla*, vol. 7, no. 2, pp. 581–585, Sep. 2022, doi: 10.30736/informatika.v7i2.866.
- [19] M. A. Kurnia, "Design of Atmega2560 microcontroller based automatic fire detector and extinguisher (in Bahasa)," *Prosiding Sains Nasional dan Teknologi*, vol. 12, no. 1, p. 551, Dec. 2022, doi: 10.36499/psnst.v12i1.7211.
- [20] A. Ahmad, "Rotatable WIFI security camera using ESP32 CAM," *International Journal of All Research Education & Scientific Methods*, vol. 10, no. 05, pp. 1017–1019, 2022, doi: 10.56025/ijaresm.2022.10506.
- [21] A. Ipanhar, T. K. Wijaya, and P. Gunoto, "Design of IoT-based automatic door monitoring system using Esp32-CAM (in Bahasa)," *Sigma Teknika*, vol. 5, no. 2, pp. 333–350, Nov. 2022, doi: 10.33373/sigmateknika.v5i2.4590.
- [22] M. F. Wicaksono and M. D. Rahmatya, "Implementasi Arduino dan ESP32 CAM untuk smart home," *Jurnal Teknologi dan Informasi*, vol. 10, no. 1, pp. 40–51, Feb. 2020, doi: 10.34010/jati.v10i1.2836.
- [23] M. Owayjan, B. Sleem, E. Saad, and A. Maroun, "Parking management system using mobile application," in *2017 Sensors Networks Smart and Emerging Technologies, SENSET 2017*, Sep. 2017, vol. 2017-January, pp. 1–4, doi: 10.1109/SENSET.2017.8125048.
- [24] P. U. Reddy and K. Naresh, "Monitoring and control of single-phase electrical systems using IoT based microcontrollers," *International Journal of Reconfigurable and Embedded Systems (IJRES)*, vol. 11, no. 3, pp. 275–283, Nov. 2022, doi: 10.11591/ijres.v11.i3.pp275-283.
- [25] P. M. V. Melvin, S. Prakash, M. K. V. Amarnath, and K. N. Kumar, "Arduino controller based borewell child rescue system," *International Journal of Reconfigurable and Embedded Systems (IJRES)*, vol. 9, no. 2, pp. 133–140, Jul. 2020, doi: 10.11591/ijres.v9.i2.pp133-140.
- [26] H. Gadupu, O. Mokharji, R. Kankaria, S. Kumar, and K. Jayavel, "ACCESS-IoT enabled smart lock," *International Journal of Reconfigurable and Embedded Systems (IJRES)*, vol. 10, no. 3, pp. 176–185, Nov. 2021, doi: 10.11591/IJRES.V10.I3.PP176-185.
- [27] M. H. Widiyanto, A. Ramadhan, A. Trisetyarso, and E. Abdurachman, "Energy saving on IoT using LoRa: a systematic literature review," *International Journal of Reconfigurable and Embedded Systems (IJRES)*, vol. 11, no. 1, pp. 25–33, Mar. 2022, doi: 10.11591/ijres.v11.i1.pp25-33.

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