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ORIGINAL

Double Loop Antenna Design For Smart Door Lock System Using Iot Applications

Diseño De Antena De Doble Bucle Para Sistema De Cerradura De Puerta Inteligente Utilizando Aplicaciones Iot

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ABSTRACT

Introduction: the rapid advancements in Internet of Things (IoT) technology have led to the development of smart door lock systems, enhancing home security. This manuscript presents the Design of Double Loop Antenna for Smart Door Lock System using IoT Applications (DLA-SDLS-IoT). The system monitors and secures entry points using sensors, a Double Loop Antenna, and an ESP32-CAM for data processing and communication. It alerts users of unauthorized access and streamlines door lock management via mobile notifications.
Methods: the DLA-SDLS-IoT system integrates components including an ESP32-CAM microcontroller, an IR sensor for obstacle detection, an OV2640 camera for facial recognition, and a solenoid door lock. Notifications are sent via Telegram, featuring images and control options. A buzzer alerts users of intruders, and the system uses Wi-Fi for internet connectivity. Programming is done in Python.
Results: the DLA-SDLS-IoT system shows significant improvements over existing methods, achieving higher frequencies, lower return losses, and lower Voltage Standing Wave Ratio (VSWR), with a higher gain. These metrics indicate superior signal efficiency and reliability compared to other systems like IoT-SSS-DLA, FA-SDLS-MCM, and SDA-LPDA-SL.
Conclusion: the DLA-SDLS-IoT system advances smart door lock technology by integrating IoT for enhanced security and user interaction. It outperforms existing solutions in performance metrics, indicating potential for widespread application. Future improvements could further enhance its functionality and user experience.

Keywords: Double Loop Antenna; ESP32-CAM; IR Sensor; OV2640 Camera; Smart Door Lock System; IoT Applications.

RESUMEN

Introducción: los rápidos avances en la tecnología de Internet de las cosas (IoT) han llevado al desarrollo de sistemas de cerraduras de puertas inteligentes, que mejoran la seguridad del hogar. Este manuscrito presenta el diseño de una antena de doble bucle para un sistema de cerradura de puerta inteligente que utiliza aplicaciones de IoT (DLA-SDLS-IoT). El sistema monitorea y asegura los puntos de entrada mediante sensores, una antena de doble bucle y una ESP32-CAM para el procesamiento y la comunicación de datos. Alerta a los usuarios sobre accesos no autorizados y agiliza la gestión de bloqueos de puertas mediante notificaciones móviles.
Métodos: el sistema DLA-SDLS-IoT integra componentes que incluyen un microcontrolador ESP32-CAM, un

sensor de infrarrojos para detección de obstáculos, una cámara OV2640 para reconocimiento facial y una cerradura de puerta con solenoide. Las notificaciones se envían a través de Telegram, con imágenes y opciones de control. Un timbre alerta a los usuarios de intrusos y el sistema utiliza Wi-Fi para la conectividad an Internet. La programación se realiza en Python.
Resultados: el sistema DLA-SDLS-IoT muestra mejoras significativas con respecto a los métodos existentes, logrando frecuencias más altas, menores pérdidas de retorno y una menor relación de onda estacionaria de voltaje (VSWR), con una mayor ganancia. Estas métricas indican una eficiencia y confiabilidad de la señal superiores en comparación con otros sistemas como IoT-SSS-DLA, FA-SDLS-MCM y SDA-LPDA-SL.
Conclusión: el sistema DLA-SDLS-IoT avanza en la tecnología de cerraduras de puertas inteligentes al integrar IoT para mejorar la seguridad y la interacción del usuario. Supera a las soluciones existentes en métricas de rendimiento, lo que indica potencial para una aplicación generalizada. Las mejoras futuras podrían mejorar aún más su funcionalidad y experiencia de usuario.

Palabras clave: Antena de Doble Bucle; ESP32-CAM; Sensor IR; Cámara OV2640; Sistema de Bloqueo de Puerta Inteligente; Aplicaciones IoT.

INTRODUCTION

The IoT, is a network of interconnected smart objects, mechanical, digital systems, objects, people, and animals may exchange data across a network without interacting by other people or objects.[1] An IoT environment is made up of smart gadgets with networking hardware, sensors, and integrated CPUs that can collect, share, and react to environmental data. By connecting to another IoT connection or any other system, IoT systems communicate the sensor data they collected. From there, the data is either locally or remotely analysed. Because of embedded development, items become linked to internal or external circumstances, which influence the choices that are made. Everyone wants to feel protected, whether it's from harm to their treasured life or their belongings. It has been making a lot of efforts lately to live a stress-free existence. This manuscript is very useful and in high demand is the smart door control system. The first line of defence for maintaining the physical safety of a home is a door. In the past, opening or closing a door required a physical key. However, with the advancement of technology, highly complex smart door lock developed that unlock or lock doors without physical key. Most people behave irresponsibly when faced with an emergency.[2]

This could be the cause of their failure to lock their home or place of work. It might also be difficult to keep several sets of keys in storage at once. Another issue arises if it misplaces or lose the keys and are left with no other option than to make extra sets of spares in order to gain entry to our home. Furthermore, a disabled person may find it challenging to lock and unlock the door if they have trouble moving close to the entry. This smart door project's primary goals are to enhance and simplify our way of life and make it easier for users to access doors in a given range. It uses buttons or voice commands to operate the lock. Bluetooth is used by this double loop antenna based smart lock system to enable wireless device control and communication utilizing a smartphone app. A relay is connected to indicate the position of the door, and an LCD is connected to show whether the doors are locked or unlocked.[3]

With the smart lock, remotely lock otherwise unlock the door without having to deal with a physical key. There are inner and outer loop antennas on a DFL antenna. The suggested antenna employs via holes and a dielectric substrate to achieve antenna downsizing. For antenna to be installed in wireless sensor device, it must be made smaller. However, wavelength dependence places a limit on antenna downsizing. Antenna miniaturization is no longer required if antenna is constructed by transparent conductor, as it put outside the wireless sensing device. Moreover, vision through windows is unaffected whether a transparent antenna is attached to a car or home's glass.[4] A quarter wavelength away from feed point are the connection points on proposed antenna, which contains double loop antenna by one wavelength. The inner, outer loop antennas are connected via these connector points. The outer loop antenna has feed point. The suggested antenna can function even in the presence of metal objects adjacent to its front or rear since it has two dimensions.[5]

In this work, combines a variety of hardware elements into a single, well-functioning system, such as sensors, microcontrollers, camera modules, and communication devices. Automation features including face recognition, obstacle detection, and remote door lock and alarm control are all integrated into the system. Users can use their mobile phones to remotely engage and operate the security system thanks to the system's integration with the Telegram application. The system links to the internet via Wi-Fi, allowing for notifications, remote control, and data interchange. Comparing the DLA-SDLS-IoT strategy to other approaches, it shows improved return loss, frequency, VSWR and gain. The method's implementation in Python gives the system more adaptability, simplicity in development, and scalability. The system improves security measures for with features including face recognition, automated door relocking, and intruder detection alerts.

Reduce electromagnetic interference (EMI) as much as possible, and make sure that the smart door lock system's electrical components don't interact with one another. Enhance the efficiency and bandwidth of the antenna to meet different requires of IoT applications for data transmission. Assess the antenna's resistance to external influences, including changes in temperature, moisture, and physical impacts. The existing technique doesn't attain sufficient accuracy; computational time is increases that are motivated us to do this investigation work.

Main contributions of this investigation work are brief as below

- In this manuscript, DLA-SDLS-IoT is proposed.
- The system incorporates a number of hardware elements, including buzzers, solenoid door locks, ESP32-CAM microcontroller, relays, cameras (OV2640), IR sensors for obstacle detection, and double loop antennas.
- The system has automated features such the IR sensor's obstacle detection, the camera module's face detection and recognition, and the relay and solenoid's door opening.
- The system's principal controller for controlling data flow is the ESP32-CAM microcontroller. It receives signals from sensors, interprets them, manages hardware, and exchanges messages and photos with other apps like Telegram.
- Through the Telegram app on a smartphone, people can communicate with the system. Users can remotely unlock the door or sound the buzzer and receive notifications on faces detected both those of known users and possible intruders.
- Devices with Wi-Fi connectivity may send and receive data, connect to the internet, and respond to user orders thanks to the microcontroller.
- To improve overall security measures, the system incorporates security elements including face recognition for user verification, automated door relocking after a predetermined amount of time, and alarm sound generating through the buzzer in case of intruders.
- When compared to other approaches, the DLA-SDLS-IoT strategy shows better performance characteristics.

Remaining part of this manuscript is arranged as below: part 2 presents literature review, part 3 describes proposed method, part 4 proves the outcomes, part 5 conclusion.

Literature review

Numerous research works were suggested in literatures were depend on Design of Double Loop Antenna for Smart Door Lock System; few of them were reviewed here.

Dansana et al.[6] have suggested IoT-depend Smart Security System on DLA. Here, IoT security with a particular emphasis on home automation. The suggested system was meant to assist a person in protecting their home against burglary; in the event that a door is broken or a password is incorrectly entered, the homeowner will be notified immediately. In addition to offering automated control over household equipment, home automation keeps burglars out of the house. It provides high gain and low frequency.

Harun et al.[7] have presented Development of Face Recognition Smart Door Lock System Utilizing ESP32-CAM, Telegram Application as Media Control and Monitoring. With the help of the Internet or Wi-Fi and the Telegram app on a smartphone, it is simple to monitor and operate the appliances. Make it simple for Kolej KediamanPagoh inhabitants to enter their houses, assist students in controlling and keeping an eye on the smart door lock to improve security. The object-oriented method was utilized to enhance system utilizing several IoT devices likes ESP32-CAM acts as microcontroller that carries input, output to switch on/off the magnetic lock,5V Single Channel Relay Module, Infrared Sensor Module, Telegram Application, KPEG-353 Piezo Buzzer. It provides Voltage Standing Wave Ratio, higher return loss.

Li et al.[8] have presented SDA of novel ultra-large planar deployable antennas in space with locking. Here, the design with analysis of a large deployable sub array, including repeated modules, with total length of 50 m and width of 7 m, was done considering carrying capacity of future heavy launchers. Furthermore, the sub array's initial folded dimensions are a mere 4,8 m × 4,8 m. Lastly, suggest an SSPS architecture by two 600 m-long solar cell arrays, one 200 m-calibre antennae made up of several sub arrays. The rigidity of simple deployable structure meets performance needs of an ultra-large SSPS, according to dynamic study for this SSPS model. It provides high frequency and low gain.

Sayeduzzaman et al.[9] have presented IoT-Integrated Home Automation and Smart Security System. Since, system makes daily living easier and boosts home protection and safety, it needs to be maintained and restored. Home automation was automatic, electronic management of household chores, activities, equipment. Android devices are equipped with the most cutting-edge technology available today. In order to enable us to operate, monitor, attain smart security system may serve as example of evolution of IoT technology with just aid of smart phone, IoT-integrated home automation by smart security system was built. It provides high return loss and low Voltage Standing Wave Ratio (VSWR).

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Zhu et al.[10] have suggested application of attitude tracking process for face recognition depend on OpenCV in intelligent door lock. The goal of the study was to give user access to OpenCV, open source program, and to efficient attitude tracking algorithm. This essay seeks to guarantee that key lock system that contemporary, vintage provides specific level of dependability, safety. The results of experiment show that the suggested system is more economical, power-efficient, and efficient. It provides high frequency and low gain.

METHOD

The proposed DLA-SDLS-IoT is discussed in this section. This section presents the clear description about the research methodology used in Design of Double Loop Antenna for Smart Door Lock System.[11] In the block diagram all the sensors, Double Loop Antenna[12] and hardware connected to the ESP32-CAM. The IR sensor act as doorbell, camera module kind OV2640 is utilize to detect, recognize user's face, relay help to unlock solenoid door lock. The door will be locked which will then be sent to telegram application in images by buttons open, still, buzzer ON, buzzer OFF connected to an Internet connection. Then, user unlock the door otherwise turn on buzzer by support of mobile phone when they get notification. The block diagram of DLA-SDLS-IoT is represented by Figure 1. Thus, the detailed description about DLA-SDLS-IoT is given below

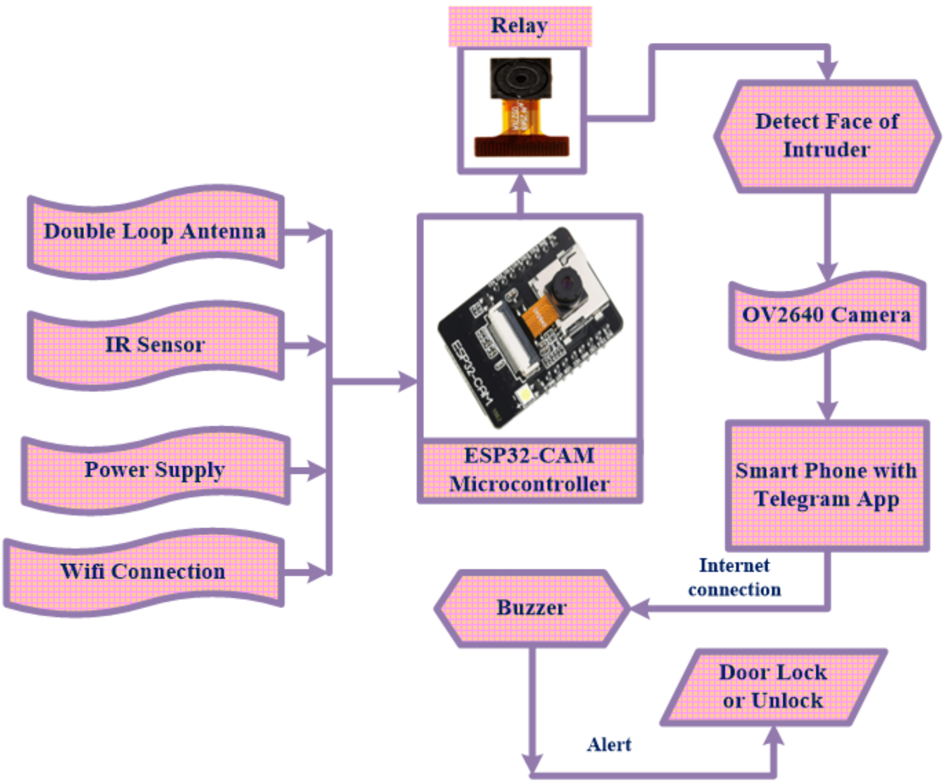

Figure 1. Block diagram of DLA-SDLS-IoTfor Design of Double Loop Antenna for Smart Door Lock System

Double Loop Antenna

Loop antennas are a preferable option for Internet of Things applications because of their lightweight and compact design, however antenna performance must remain consistent even in situations where metal is present near the antenna, which is a common occurrence in IoT applications. The antenna is double loop, with one wavelength. The outer loop antenna will serve as the feed point. Due to its two dimensions, the suggested antenna may operate in both the S- and X-bands, even in the presence of metal objects directly in front or behind it. When a single loop antenna is positioned next to a metal plate, it is observed that the parameters that define the antenna's performance, such as radiation pattern, VSWR, and gain, are decreased; however, in the case of a double loop antenna, these parameters are not altered. A double loop antenna is created utilizing a glass substrate with relative permittivity of 5,5, line width of 1mm. The antenna's length and width are 36mm and 36mm, respectively, and its thickness is 1. 5mm.Comparing the realized double loop antenna to the double loop antenna developed using polycarbonate as the substrate and a permittivity of 2,9, the latter showed 2,5 dB greater gain. The figure 2 represents the geometry of double loop antenna as mentioned below.

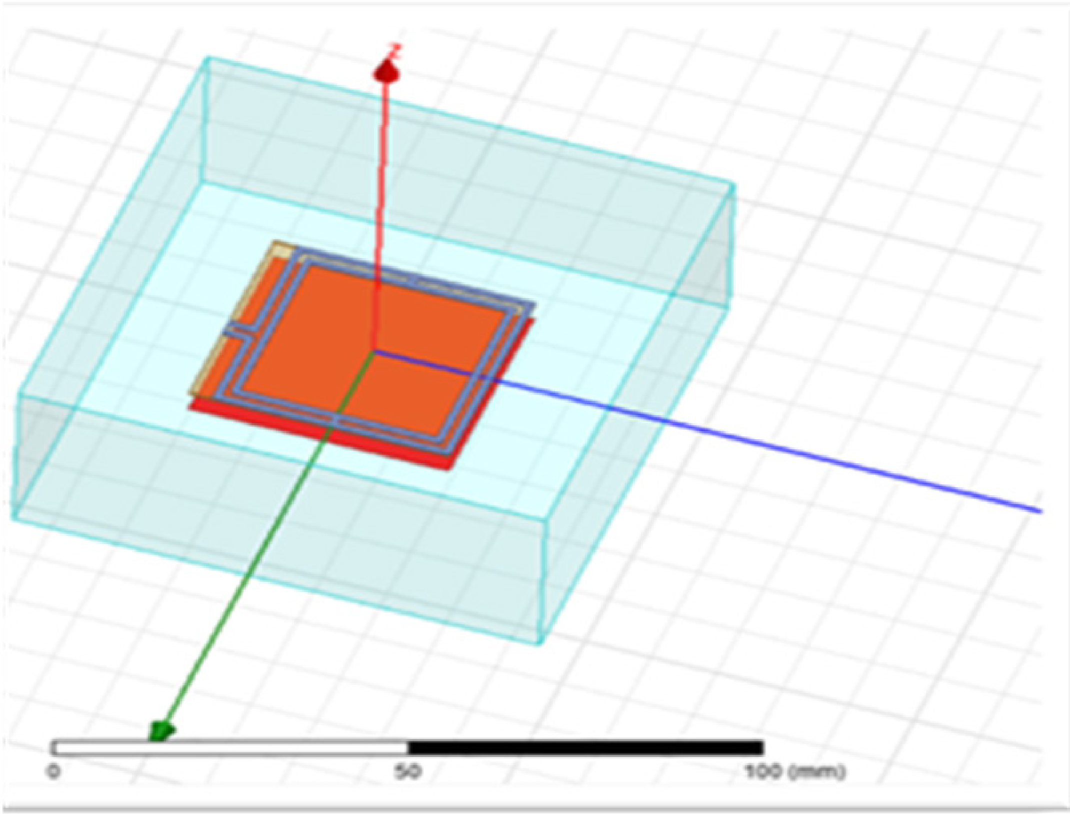

Figure 2. Geometry of Double Loop Antenna

Figure 3 displays the return loss for the double loop antenna in the HFSS that has silver conducting on a glass substrate, matching Figure 2. The return loss is shown in Figure 3 to be -11,9607 at 2,1 GHz and -17,9122 at 9,0 GHz. Its second resonant frequency is 9 GHz, and its centre resonant frequency is 2,4 GHz, according to the intended parameters.

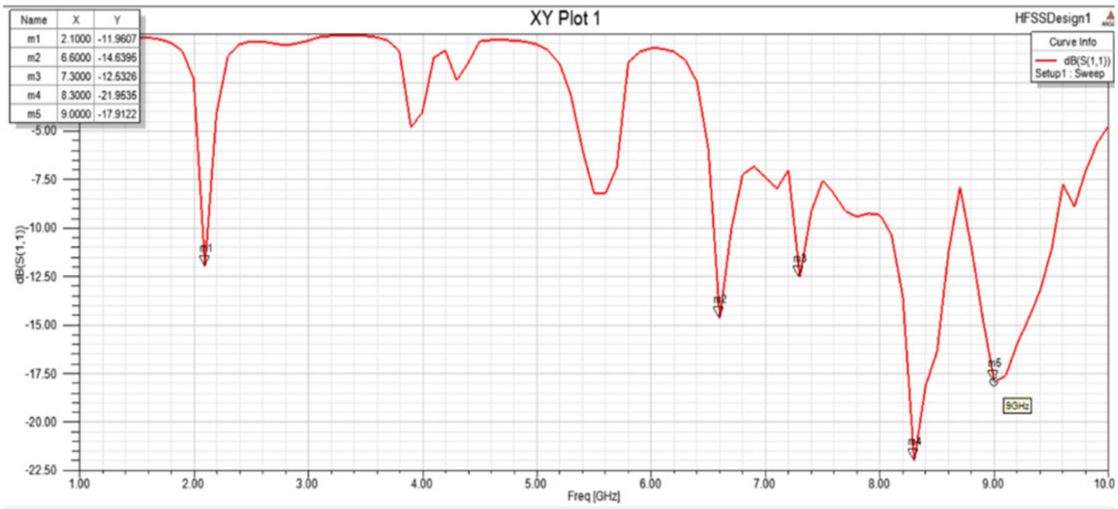

Figure 3. Return loss for double loop antenna with silver conducting on glass substrate

A perfect match is indicated by a minimum VSWR of unity. Figure 4 displays the VSWR for the double loop antenna in the HFSS that has silver conducting on a glass substrate, matching Figure 2. It should, in theory, be between one and two. Figure 4shows that the VSWR is 1,2914 at 9,0 GHz and 1,6750 at 2,1 GHz.

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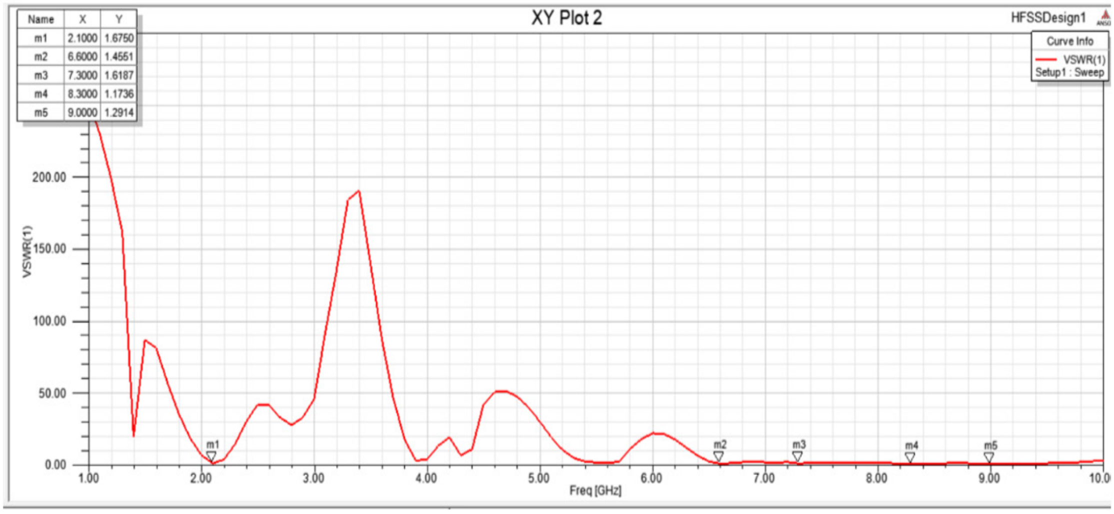


Figure 4. VSWR for double loop antenna with silver conducting on glass substrate

The power transmitted per unit solid angle is known as gain. Figure 5 displays the 3D Gain for the double loop antenna in the HFSS that has silver conducting on a glass substrate and corresponds to Figure 2. Any antenna has a gain of greater than 3dB for all uses. At 2,1 GHz and 9,0 GHz, the antenna's measured gains are 5,8839 dB and 9,4215 dB, respectively.

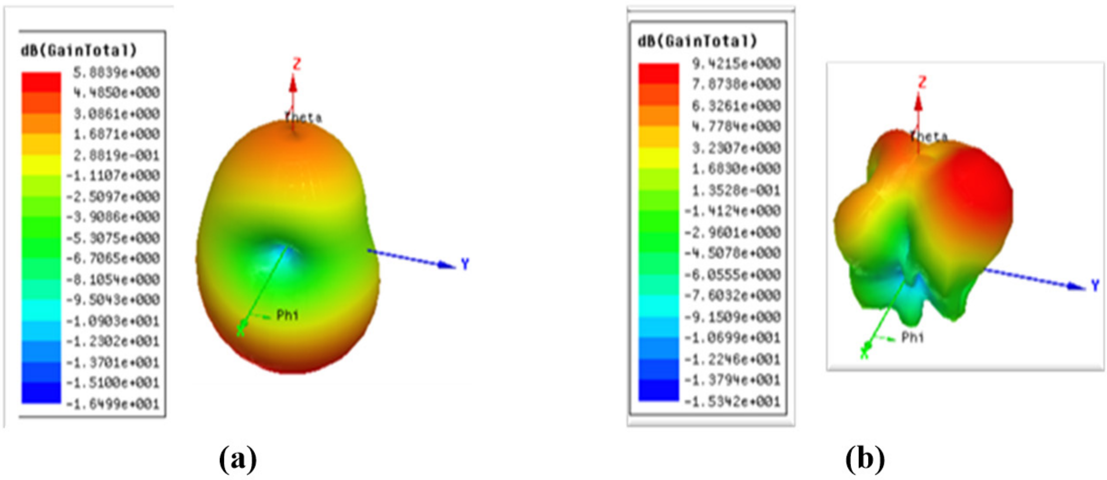


Figure 5. (a) Gain at 2,1GHz, (b) Gain at 9,0 GHz

The table 1 below displays the findings for a double loop antenna developed in HFSS that uses a glass substrate and silver conducting.

Table 1. Results of proposed double loop antenna

Frequency	2,1 GHz	9,0 GHz
Return Loss	-11,9607 dBi	- 17,9122 dBi
VSWR	1,6750	1,2914
Gain	5,8839 dBi	9,4215 dBi

The table 2 below compares the performance of single and double loop antennas in the presence of metal. It can be shown that the double loop antenna outperforms the single loop antenna while operating at both S-band and X-band frequencies.

Table 2. Comparison of proposed double loop antenna with single loop antenna with metal in proximity

Antenna Type/ Parameter	Single Loop Antenna	Double Loop Antenna
Frequency	8,2 GHz	8,5 GHz
Return Loss	-15,3042 dB	-38,1557 dB
VSWR	1,4146	1,0250
Gain	6,5166 dB	7,4046 dB

Below are the real-time findings from a double loop antenna that was constructed on a glass substrate and using silver conductors as follows the figure 6 and figure 7,

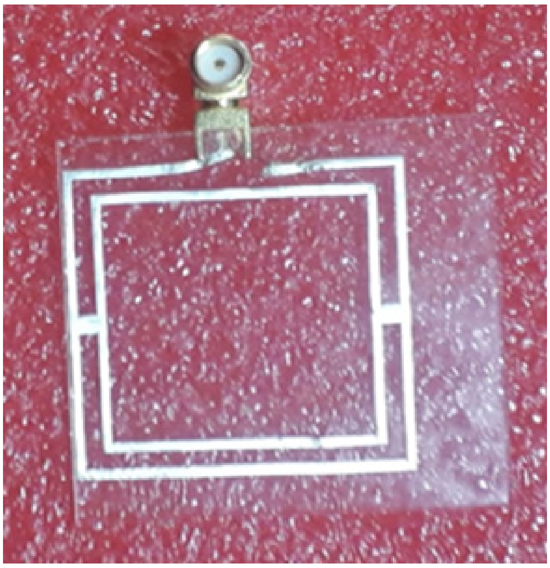
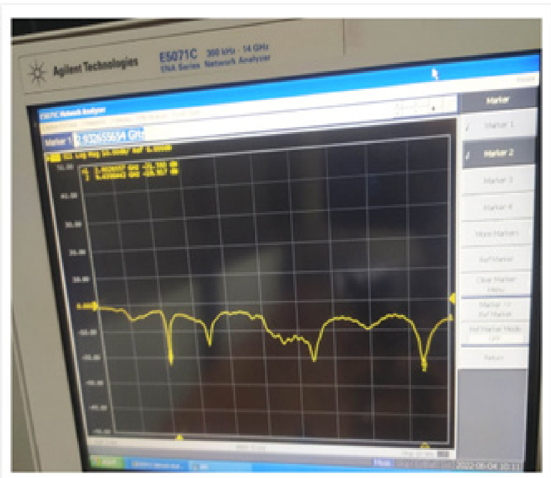
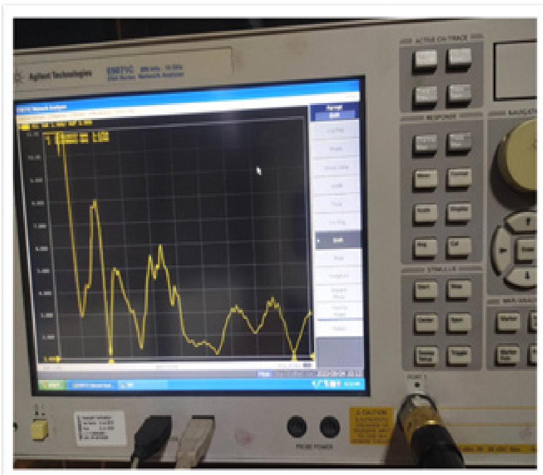


Figure 6. Fabricated Model



(a)



(b)

Figure 7. (a) Return Loss in Network Analyser, (b) VSWR in Network Analyser

Working function

The proposed method DLA-SDLS-IoT require a collection of electromagnetics, such as an ESP32 CAM (for face capture), a UART TTL programmer, a double loop antenna, a relay module, a solenoid lock, LEDs (red and green), a breadboard (for connections), etc.[13] to construct a face recognition door. Wires for connecting, a

100uf 16v Capacitor, a 7805 regulator (which provides 5 volts), and a 12-volt power supply or battery can also be used. Let's now examine how the ESP32 camera board and facial detection automated door lock system is connected.(14) The ESP32 camera and a 3-volt power module (it can switch to a 5-volt power module if necessary) should be attached to the breadboard first, then the wires should be connected, with the red lines denoting a negative voltage and the green wires a positive voltage. The next step is to create a code (mainly in C#). In that code, it should include the Wi-Fi name (also known as the Wi-Fi SSID) and the Wi-Fi password. Before continuing, it also needs to choose a few options from the Tools tab. The next step is to upload the code and breadboard details to it using the jumper cap that connects to IO and ground. To obtain the IP address for the next step, it must first choose the board rate and restart. Once it receives the address, it must copy it and open it in our browser. Next, since the ESP32 camera and our relay module both require 5 volts to function, it must connect all of the project's parts to the breadboard, which has a 7/8 0-5 regulator to convert 12 volts to 5 volts. This solenoid lock operates on 12 or 9 volts, so it needs to use a 12- or 9-volt batteries. If it uses a 5-volt cell independently, it won't require a regulator. Once every connection has been made, a red LED light that indicates the power.

Hardware Development

In this manuscript, the bell button is replaced by an infrared sensor. The relay utilizes the electromagnetic principle to move the switch contacts. Higher voltage electricity can be delivered by the relay when the electric current is minimal (low power). In order for the door lock solenoid to function, power supply and relays must be used.(15) The door lock solenoid and relay both receive 12V power from the power supply. When positive power supply pin is linked to NO relay, negative power supply is linked to negative solenoid door lock, positive solenoid door lock is linked to COM relay, voltage changes to 5V. Relay output pins connected to GPIO12, GND to GND, VCC to VCC are connections between relay and ESP32-CAM.

The buzzer has two wires that go to ESP32-CAM. On ESP32-CAM, positive pin is linked to GPIO15 pin, negative pin is connected to GND. Upcoming technology Devices International on ESP32-CAM is meant to enable a successful connection between the module and the Arduino IDE application when the source code is entered. Devices for converting transmission to and from the computer's USB (universal serial bus) are supported by FTDI. the completed smart door lock system prototype, which was constructed from cardboard and other recyclable materials. For this project, the primary prototyping module is the ESP32-CAM. When the ESP32-CAM experiences a system issue, it can be used for direct resident access via facial recognition, and for guest entry through a telegram notice that initiates the room's opening via a smartphone. It is also employed in order to identify potential robbers. Multiple pins are utilized to link the various components to the ESP32-CAM board. Like a doorbell, the IR sensor operates. The implementation of smart door lock system on the dorm room door is the outcome of this hardware.

Software Development

The Arduino IDE is used to program the ESP32-CAM in this prototype. The Telegram application can be accessed straight from a defined Wi-Fi connection thanks to the program's layout. It's possible that ESP32-CAM is a tiny, low-power camera module that supports ESP32. It offers an inbuilt TF card slot, OV2640 camera. Intelligent Internet of Things applications likes wireless video monitoring, QR identification, Wi-Fi picture upload, others frequently make extensive use of the ESP32-CAM. With a footprint of just 40 x 27 mm, the OV2640 Camera Module 2MP for Face Recognition in ESP32 CAM Wi-Fi Module Bluetooth offers very competitive small-size camera module function independently as minimum system.

System with Telegram

In this manuscript, the homeowner gets alerted of an unfamiliar figure at the door via Telegram. Both text and an image contain it. As long as the software is installed, Telegram is a free program that can be downloaded and used on a variety of devices. Additionally, Telegram Developer offers an Application Programming Interface (API) that may be coded in a variety of languages, including Python and, in this instance, lengthy method poll. How to establish a view Telegram Bot that users can see is explained below? For, as well as how to link Telegram with the Arduino IDE, may be made through the Telegram online application or the Telegram app on a smartphone. An instruction to construct our bot's username will appear; it must contain the word "bot." Next, copy the code; our API tokens are represented by a number. Later on, bots that can be programmed to deliver text, photos, videos, and other types of media will use this token as a model.

In face recognition system phase, the ESP32-CAM's display feature serves as a webserver for the identification system face. This page will have a notification on the shown face and a live mechanism to identify faces that have been previously registered or not.

In live streaming page, a page designed to show the home page of a website is called an index page. The website's home page is designed to showcase the live streaming feature.

In telegram notification display, the system adds notifications when the door is opened and triggers Telegram alerts when it detects visitors, intruders, or strangers. Use the photo command to tell ESP32-CAM to take picture, which will then be sent over Telegram. If you hit the "/open" button, the door lock solenoid will open; if you press the "/still" button, you can snap front-facing photos. When the system detects a thief, the user manually presses "/buzzer ON," and pressing "/buzzer OFF" silences the buzzer.

System Integration with IoT

As a prototype, this constructed antenna is combined with a planned and created Internet of Things system for smart door locking, and its functionality has been tested as seen below figure 8.

Figure 8 show that the model of a house with smart door locks system and figure 9 shows that Internal Circuitry Connections with fabricated Antenna. An ESP-32 CAM, which is in charge of taking and uploading images of the person standing close to the door to the cloud, and a software program like the Telegram app, which allows for internet-based control of the system's whole functionality, are employed in the design and development of the IoT system for smart door locking. The antenna that is already present in the ESP-32 CAM is used and bypassed in favour of the developed and manufactured double loop antenna, as indicated by the connections below.

Figure 8. Model of a house with smart door lock system

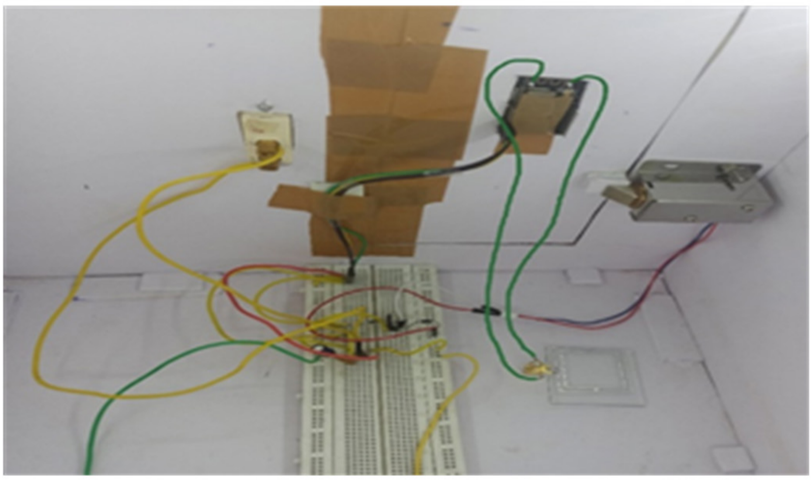


Figure 9. Internal Circuitry Connections with fabricated Antenna

Figure 10 shows that the Internal picture of circuit with fabricated antenna in the house model with smart door lock system and Figure 11 shows that Connections to disable the inbuilt antenna and enable external designed antenna. Solder the R2 & R3 and de-solder the R2 & R1 in order to disable the built-in antenna on the ESP-32 CAM Board. The ESP-32 CAM board's functionality remains unchanged even after replacing the antenna

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with the intended one. The ESP-32 CAM continues to function as intended, producing identical outcomes. The process begins when someone presses the calling bell in figure 3.

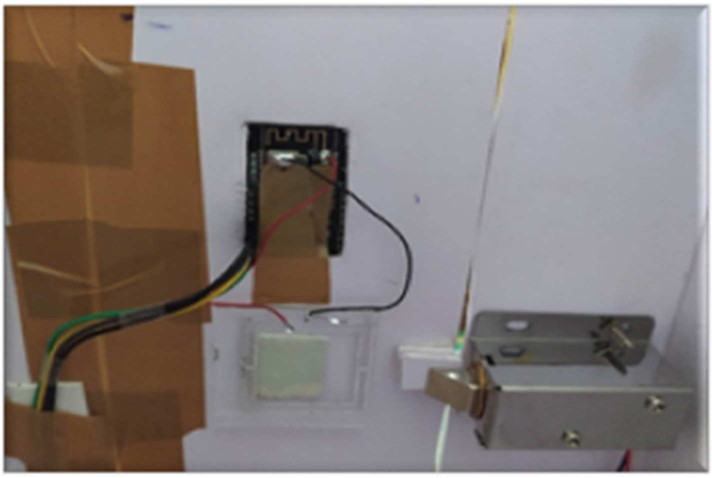

Figure 10. Internal picture of circuit with fabricated antenna in the house model with smart door lock system

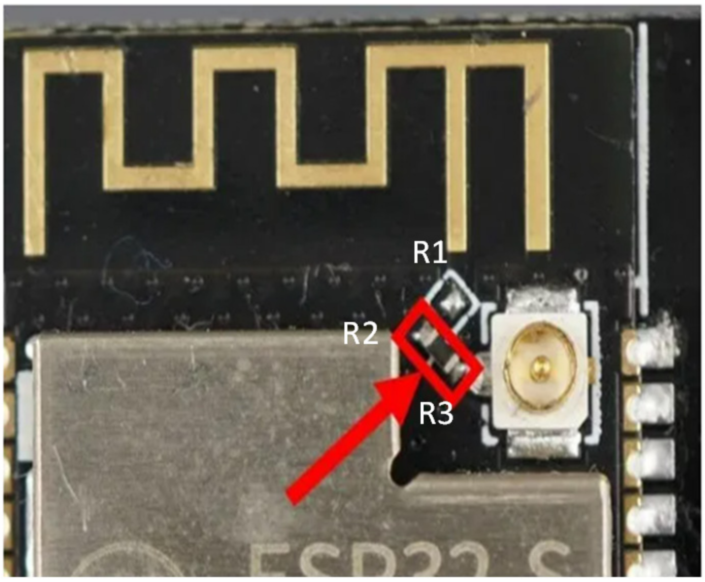

Figure 11. Connections to disable the inbuilt antenna and enable external designed antenna

The ESP-32 Camera module then takes a picture of the individual and sends it to the admin's mobile app. if the administrator knows the person. If the administrator issues a UNLOCK command, the door will be in the LOCK state, as seen in figure 12.

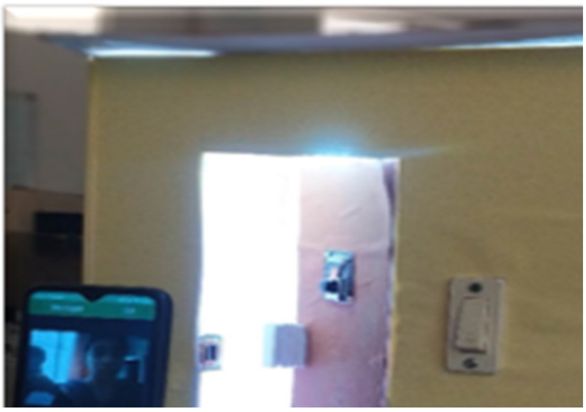

Figure 12. Depicting the unlocking of door when UNLOCK command given from Telegram App

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RESULT

It includes testing of Internet connectivity, ESP32-CAM Testing system, Testing of Telegram Notifications and testing the camera's OV2640 sensor which are explained below,

Internet connectivity for the ESP 32-CAM

The ESP32-CAM microcontroller is equipped with Wi-Fi, which enables it to establish connections and establish communication with other devices via the internet. In this experiment, ESP32-CAM is connected to internet via smartphone acting as a modem. The connectedness between them is examined using the five experimental data points by dividing them up over different distances. The smartphone and the ESP32-CAM were separated by 1,000 and 110 000 meters, respectively. There is a maximum distance of 100 meters that the ESP32-CAM can connect to the internet due to the limited range of the ESP32-CAM's WIFI connection to smartphones. 802,11n is the WIFI standard, and it supports signals up to 100 meters above ground. Furthermore, other elements that may impact connectivity include the building's architecture, the quantity of windows, impediments, and interference from other electronic devices. It may decrease the ESP32-CAM's internet connectivity.

ESP32-CAM Testing system

Examine the web server characteristics of the ESP32-CAM and compare the results of two persons' detection of six faces. A testing mechanism to open the door by unlocking the solenoid door lock; ten experiments were carried out to show the efficacy of this method. The faces in the database are displayed, and there are two registered faces. There is an identification indicator installed on the face of a failure system. The ESP32-CAM demonstrated successful face detection and recognition in experiments 1, 2, 3, and 4. In tests 5 and 6, it also detects strangers with success. In contrast, the ESP32-CAM was tested in tests 7, 8, and 9 using weirder photographs. In the last experiment, toys are used to test the detection, however the system is unable to do so.

Testing of Telegram Notifications

This manuscript demonstrates the system's needed reaction time and success rate for Telegram notifications.[15] The biggest delay, 4,92 seconds, is needed for the system recognition process before Telegram receives the image and text data; the quickest delay, 4,82 seconds, with average delay of 4,87 seconds, is needed. The system functions properly first time, which is why. In order for the system to transfer data to Telegram once data storage and matching are finished, it will first do training, save the data to the library, and then perform matching. The file size and internet speed on the ESP32-CAM will affect the data sent to Telegram.

Testing camera's OV2640 sensor

To find the ratio of distance camera OV2640 sensor produces, the sensor is tested. The results are encouraging because there was no change in five tests when sensor spotted object. The low-level standards supported by the microcontroller enable the OV2640 camera to capture and process photos of objects in room. A cable attached to OV2640 camera sensor that has wide-angle lens, 160-degree viewing angle, compensates for module. It permits the gathering of pictures at a maximum refresh rate of 15 frames per second, a resolution of up to 1600x1200. The low-level protocols used by the microcontroller.

The experimental outcomes of DLA-SDLS-IoT are discussed. The suggested method is then simulated in python using the mentioned performance indicators. The obtained output of DLA-SDLS-IoTmethod is examined with the existing IoT-SSS-DLA, FA-SDLS-MCM and SDA-LPDA-SL methods.

Performance measures

It is an essential task to choose the ideal classifier. The performance of proposed method is examined utilizing performance metrics such as Frequency, Return Loss, VSWR and Gain. The performance metric is deemed to calculate the performance metrics.

Frequency

The precise range of radio frequencies or electromagnetic waves that an antenna is intended to effectively transmit or receive is referred to as its frequency.

Return Loss

The amount of signal that an antenna transmits that is reflected back as a result of impedance mismatches is known as return loss. It is calculated using the following formula and is represented in decibels (dB) in equation (1):

$$\mathrm{Re}\,turn\ Loss\,(dB) = -10 \times \log_{10}\left(\frac{P_{reflected}}{P_{incident}}\right) \tag{1}$$

Voltage Standing Wave Ratio (VSWR)

An additional metric for assessing how well an antenna transmits power from transmitter to antenna, vice versa is VSWR. It can be quantitatively defined as follows and is determined as ratio of maximum voltage to minimum voltage along transmission line in equation (2):

$$VSWR = \frac{V_{\max}}{V_{\min}} \tag{2}$$

Gain

An antenna's gain is its capacity to focus or guide a signal, either transmitted or received, in a certain direction. It is commonly expressed in decibels (dB) in relation to a dipole antenna or an isotropic radiator (dBi). Here the equation (3) is the gain in dB formula:

$$Gain(dBi) = 10 \times \log_{10}\left(\frac{Radiation\ Intensity\ of\ \mathrm{Re}\,ference\ Antenna}{Radiation\ Intensity\ of\ Antenna}\right) \tag{3}$$

Performance Analysis

Figure 13-16 determines the experimental outcomes of DLA-SDLS-IoT method. Then, the proposed DLA-SDLS-IoT method is compared with existing IoT-SSS-DLA, FA-SDLS-MCM and SDA-LPDA-SLmethods respectively.

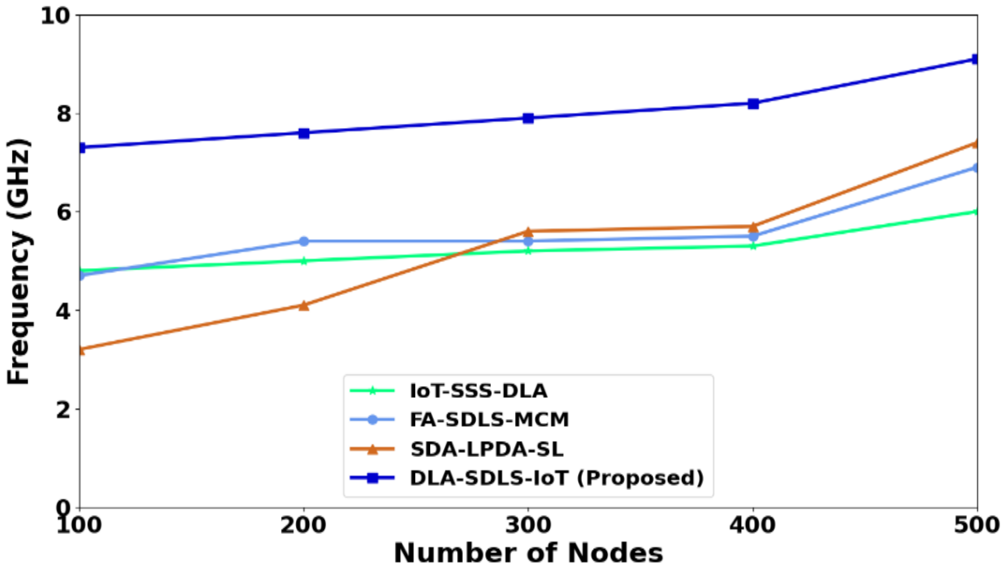

Figure 13. Frequency analysis

Figure 13 depicts Frequency analysis. Hertz (Hz) is the unit of measurement for frequency, with low frequencies on the left and high frequencies on the right represented by the x-axis. The antenna's response is shown on the y-axis and can be expressed as gain, impedance, or any other pertinent quantity. The resonance frequency, at which the antenna operates most efficiently, is indicated by the curve's peak. The proposed DLA-SDLS-IoT method attains 18 %, 16 % and 19 % higher Frequency compared with existing IoT-SSS-DLA, FA-SDLS-MCM and SDA-LPDA-SL models respectively.

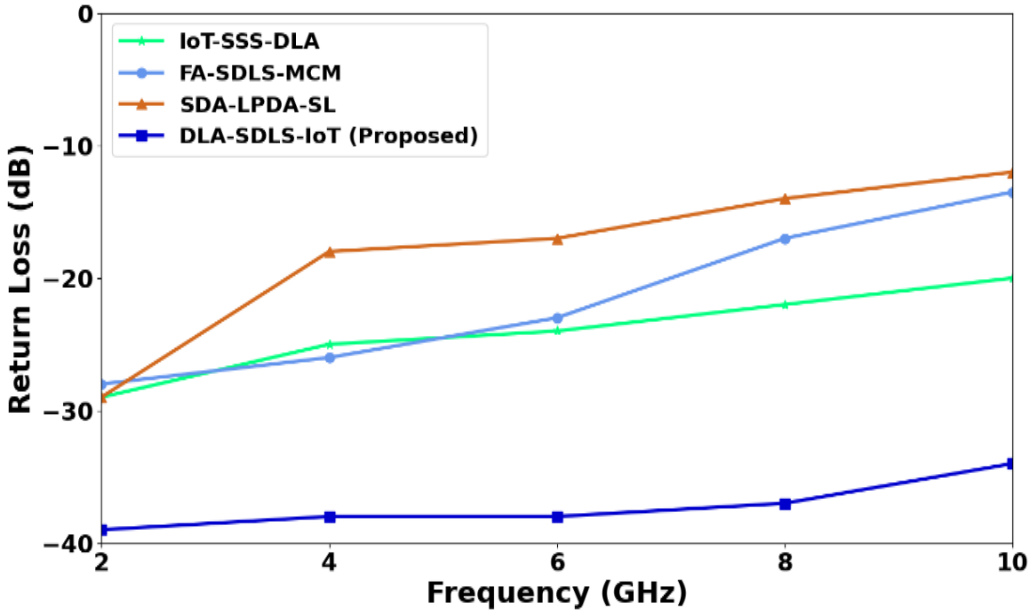

Figure 14. Return Loss Analysis

Figure 14 depicts Return Loss analysis. One or more peaks on the graph could represent resonance frequencies for the antenna where the best impedance matching and lowest return loss are observed. The frequencies at which the antenna efficiently transmits or absorbs electromagnetic energy are represented by these peaks. The DLA-SDLS-IoT method attains 13,67 %, 27,55 % and 14,67 lower Return Loss compared with the existing IoT-SSS-DLA, FA-SDLS-MCM and SDA-LPDA-SL methods models.

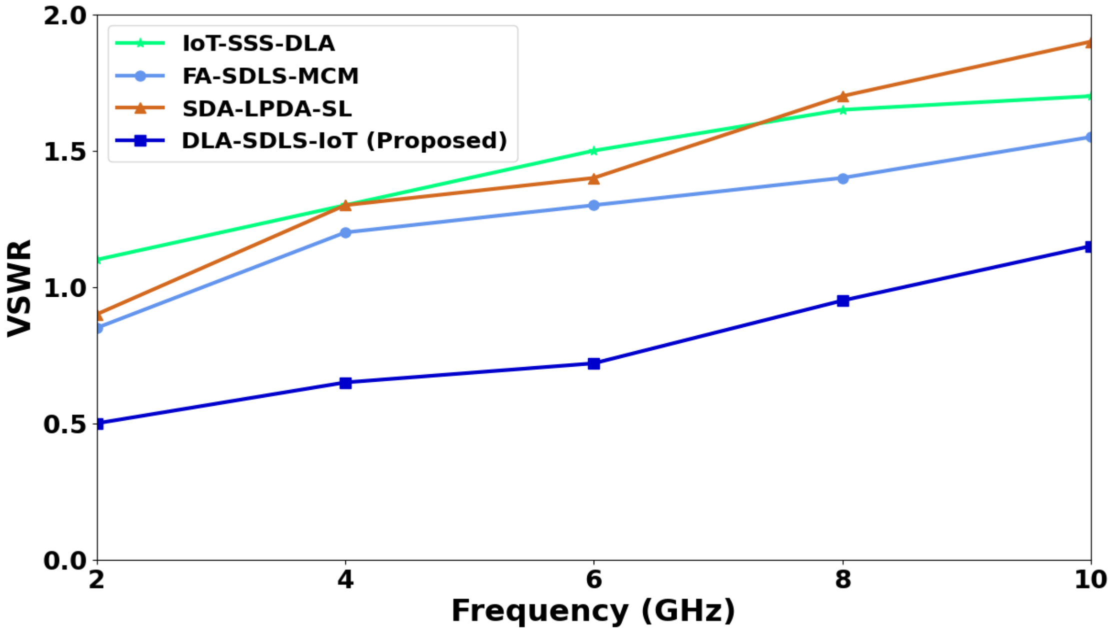

Figure 15. Voltage Standing Wave Ratio Analysis

Figure 15 displays Voltage Standing Wave Ratio analysis. It would map desired frequency range for your double loop antenna design along the x-axis. Plotting the VSWR values at every frequency point along the y-axis is done. The proposed DLA-SDLS-IoT method attains 16,55 %, 24,12 % and 27,22 % lower Voltage Standing Wave Ratio (VSWR)estimated to the existing IoT-SSS-DLA, FA-SDLS-MCM and SDA-LPDA-SL models.

Figure 16 displays Gain analysis. The frequency range, which runs from 1-100 MHz in megahertz (MHz), is represented by the x-axis. The antenna gain is shown on the y-axis as decibels (dBi), with a range of -10 dBi to 20 dBi. The Double Loop Antenna’s gain pattern across the frequency range is shown by the line. The proposed DLA-SDLS-IoT method attains 12,07 %, 13,05 % and 15,67 % higher Gainestimated to the existing IoT-SSS-DLA, FA-SDLS-MCM and SDA-LPDA-SL models.

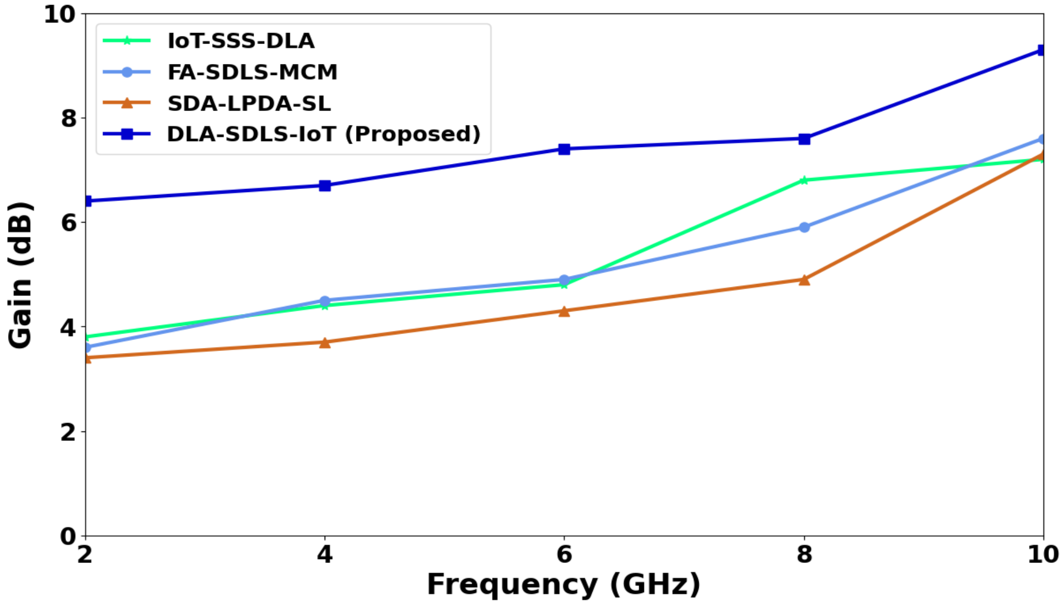

Figure 16. Gain Analysis

DISCUSSION

A DLA-SDLS-IoT model to design antenna for smart door lock system is developed in this paper. This system will assist users in managing and minimizing energy resource waste, particularly in light of their daily workload. To create smart door lock system by creating software that enhance a transportable, highly effective, reasonably priced, and simple to use security system that can stop house theft incidents from happening. Its smart entry lock has a wide-angle camera built in. Use facial recognition or use the high-resolution, wide-angle lens to automatically let someone in once user entrance has been unlocked to develop an IoT-based system that alerts the user when a stranger attempt to enter or visit the home. The Telegram application, double loop antenna and the ESP-32 CAM serve as the papers core centre and conduit for communication.

CONCLUSION

In this section, Computer-Vision Classification of Corn Seed Varieties using Optimized Pyramidal Dilation Attention Convolutional Neural Network (DLA-SDLS-IoT) is successfully implemented. The proposed DLA-SDLS-IoT is executed in python. For Internet of Things applications such as the telegram application-controlled door locking system, a double loop antenna with real-time functionality has been successfully designed, constructed, and tested. Even when near metal, the double loop antenna with silver conducting on glass substrate worked well for Internet of Things applications with a centre frequency of about 2,4 GHz and wireless communications with a centre frequency of around 9,0 GHz. This antenna is easy to build and connect with IoT systems due to its straightforward construction. Results from the experiment demonstrate that the suggested antenna operated flawlessly in real time.The performance of the DLA-SDLS-IoT approach contains 18 %, 16 % and 19 % higher Frequency; 13,67 %, 27,55 % and 14,67 lower Return Loss; 16,55 %, 24,12 % and 27,22 % lower Voltage Standing Wave Ratio (VSWR); 12,07 %, 13,05 % and 15,67 % higher Gainwhen analyzed to the existing IoT-SSS-DLA, FA-SDLS-MCM and SDA-LPDA-SL methods respectively.It is suggested that more paper be done with directional antennas to extend the ESP32's Wi-Fi range and create better microcontrollers for next papers. ESP32-CAM has the option to switch to a newer, more powerful Raspberry Pi version that offers greater functionality and security, or it can update to the most recent version available on the market. Future system improvements can be achieved by refining the database's code.

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