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Conceptual approach on smart car parking system for industry 4.0 internet of things assisted networks

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ABSTRACT

The deployment of Internet of things (IoT) technology has enhanced various applications in scientific disciplines such as medical, agriculture, social sciences, and computer sciences, as well as non-scientific sectors such as government, society, and industry, among others. IoT manifests itself in a variety of fields that are divided into categories based on the issues that may be handled, such as health, agriculture, networks, cities, and sports. Parking guidance development entails the creation of an IoT-based system that transmits information about available and occupied parking spaces via a web/mobile application. Each parking space has an IoT gadget, which includes sensors and embedded systems. The user is given a real-time update on the availability of all parking spaces and is given the option to pick the optimal position. This study is centered on fully automated parking area utilizing image analysis, as well as or before parking places with sensing and OTP generating. The car park reduces the need for user interaction, increases wage costs, and allows for space well before. The Autonomous Vehicle Parking System allows users to park their cars without the need for human interaction and operates 24 h a day, seven days a week. The Pre-Booking software allows the user can reserve a parking space via this app, reducing the customer's time spent hunting for a parked spot and energy usage. There is still a notification that shows if a space is reserved or available.

1. Introduction

The Pre-Parking Technology allows users to select desired parking spot via an Android device, and an OTP is created for the designated user and kept in the server. The customers are distinguished by their license plate, as seen in Fig. 1. If the cameras indicate the existence of a car in the designated slot, the app prompts the designated users to input an OTP, and if the OTP may not correspond, an alarm is triggered. If the sensor consists of an automobile, the CCTV in the Autonomous Smart Parking takes an image of it. Image Processing is used to transform the registration number into words, which is then entered in a record with the IN time. If the same license plate is recognised in Exit, the OUT time is computed and the associated bill amount is created. The cash is distributed via Tickets Vending Machine. For a good sense, there is also a monitor indicating the reserved and available parking spaces.

The Technology is a broad realm in which everyone and anything can be linked to the network via some kind of data collection mechanism. As illustrated in Fig. 2. In this time of technology, we are attempting to reduce their effectiveness in a variety of ways, and the introduction of such Arduino and IoT phases has expanded the scope of this possibility in our normal everyday lives. Finding available parking areas in various open areas such as medical facilities, office retail centers, movie corridors, courts, colleges, and institutions is among the important difficulties that we are dealing with in today's overcrowded society.

According to statistics, dissatisfied cars travelling around the plaza looking for parking areas account for nearly 20% of all downtown traffic. The authors recommended to shorten the time it takes to hunt for an available parking place and, as a result, to minimize air pollution. The programming architecture has been developed to improve the performance of discovering and including the number of vehicles in the parking space. The most of frameworks employ deep learning to identify

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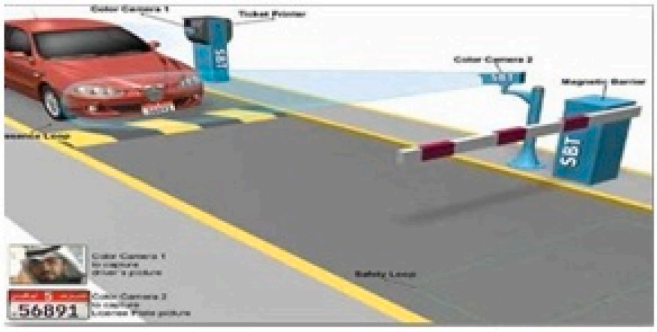

Fig. 1. Number Plate Recognition using CCTV Camera.

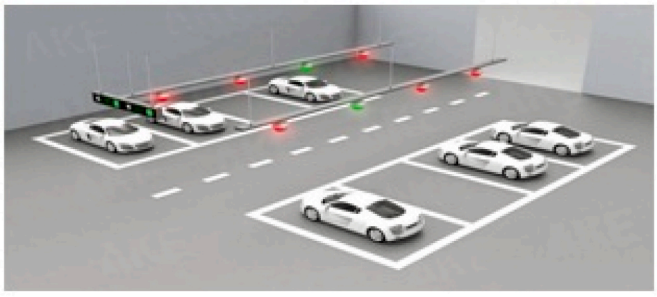

Fig. 2. Status of booked and vacant slots.

and count each visible parking place [1,2]. Because interior covers parking usually contains security cameras that provide a visual of the parking structure, it may be interesting to use an image processing algorithm to recognize and include the available parking space in the interior covered parked vehicle [3].

A significant advancement in current data technologies with regard to all industries activities in the current time sparked interest in getting care of cars as potential consequences in data frameworks. A person or a specific brainy kit capable of recognizing automobiles by their license plates in the real world and diverting it into a theoretical approach should be able to investigate important information depicted by automobiles to reality and information goals. Security concerns are another critical topic to concentrate on in transport layer security.

As the number of cars and trucks grows, it is becoming increasingly difficult to find parking for a wide range of experts and educators at Scholastic Centers or in multi-story flats. A large number of automobile parking places are watched by manually by safety monitor guards who are not interested in following the number of trucks that arrive and leave such parking spaces. This makes it extremely difficult for the motorist to find an open space for their car to go, which necessitates the use of extra time, not to mention the anxiety and fear that perhaps the driver experiences. Its non-appearance of a sheltering guardian can occasionally result in automobile burglary.

The goals of an automated parking system using unique techniques are the subject of this study. The first section discusses the introduction of IoT as well as data on manually available parking. Section 2 displays the study and the issues encountered with manually parking methods. Section 3 outlines the goals of the proposed technique for a parking management system. Finally, the results its conclusion is presented.

2. Literature survey

[4] developed ways for automatic monitoring of cars stopped in the income distribution utilizing number plate object detection. The cumulative intensity is computed in order to identify the projected parameters and orientation. In addition, the locations of license plates are being used to find the position of a placed automobile in a picture of a parking garage. However, photos of the vehicle with license plates must be examined at periodic intervals about any potentially dangerous activities.

Mostafa Didar Mahdi et al. [5] researched smart parking spot allocation on Dhaka's rural roads. The researchers used custom-built stress sensors to detect open parking spaces and adjusted parking layouts accordingly. The model is known as EZ parking, and it comprises of a Smartphone application that is linked to sensors. Unfortunately, the parking places available here are limiting to only 6 vehicles.

Louis Touko Tcheumadjeu et al. [6] explored the use of IoT to

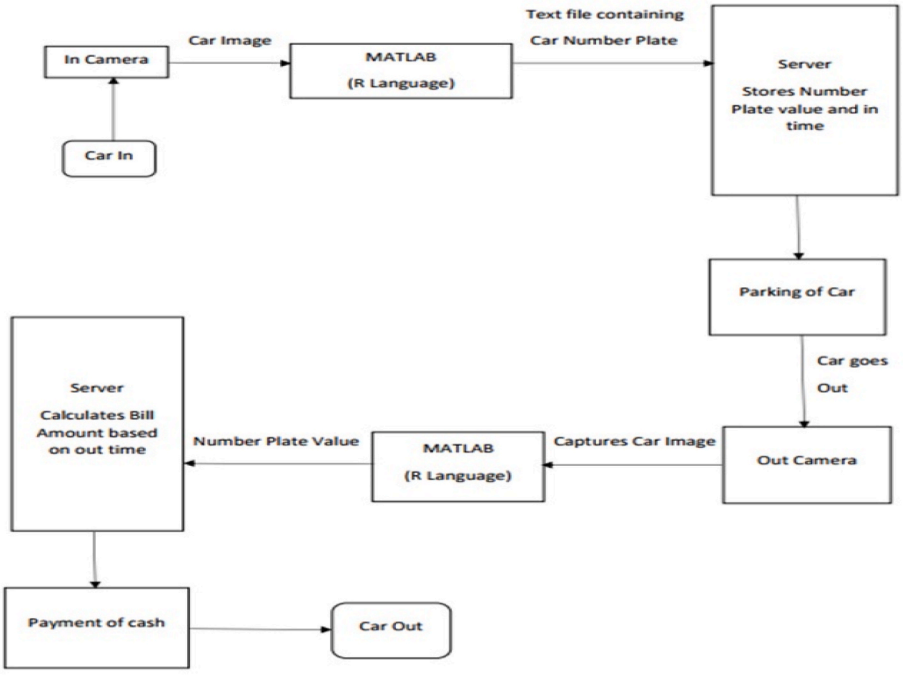

Fig. 3. Automatic car parking using CCTV image processing.

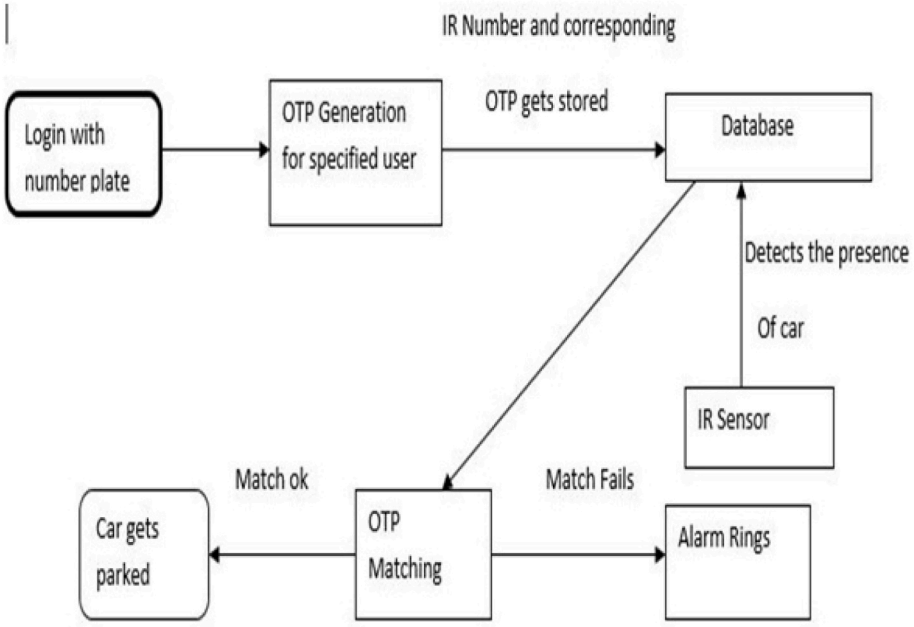

Fig. 4. Flowchart for pre-booking.

integrate an autonomous concierge parking system. To execute the situation with actual data interchange during drive and park, an autonomous mechanism was used. The researchers, though, did not take into account manually or non-cooperative automobiles travelling in the same region.

[7] concentrated on the usage of IoT to construct a smart transport network. The authors developed a smart signboard made up of sensors that detect vehicle motions. The signboard sensor controls some of the ecological changes that occur in the climate and temperature. However, the writers focused on monitoring instead of improving parking amenities.

Sarthak Mendiratta et al. [8] presented the procedure of an intelligent smart parking with a visualization tool and IoT. Here, acoustic sensors are utilized to locate open spaces and transmit the data over the internet. The status of the parking evaluation, on the other hand, is handled via a third-party service.

Vidhya Sagar et al. [9] demonstrated the use of a Smartphone app to construct an IoT-based automatic sensor network. To provide autonomous parking, data is delivered over the GSM network. Despite the services offered, there is no emphasis on parking alarms in the old model.

2.1. Gaps in literature

By comparing the proposed operation to the current works, we may see where the differences are. They are as follows:

i. The program's GPS and GSM technologies are employed to satellite services. However, the protection of these data from a variety of anti-social acts is not being taken into account.
ii. Existing efforts prioritize notice of an incident after it has occurred rather than prevention. The alert is not saved for future use.
iii. Literature suggests that existing studies focus solely on human-caused malfunctions instead of collaborative surveillance of both people and automobile malfunctions.
iv. The research of IoT is progressing slowly in the domain of robotics, resulting in complex applications.

A suggested one is the robotic garage (RG) that uses Bluetooth to effectively execute the positioning of a parked car without the motorist's assistance. The technology automatically examines the registration number recorded in the Bluetooth chip (BC) to determine whether the new car requires parking. The method uses a rack and pinion (RaP) device to transfer the car to a storage place. RFID, which was chosen as the best, had certain security problems. It can also be hard to configure RFID tags in all vehicles [10–12].

3. Research objectives

The primary aim of this research is to implement image analysis in CCTV cameras so that details about license plate and IN time may be automatically entered in a database. IR sensors can detect the position of a vehicle at the entry, leave, and parking space. Anyone with a Smartphone can download this app and reserve their preferred time slots ahead of time. Number Plates are being used to authenticate each pre-booking user. Every customer who pre-books receives an OTP, which is verified at the period of parking. The alarm system is used to notify the user if the automobile is not pre-booked and is parked in a non-pre-booked spot. Perceptive are used to show the condition of the slot, such as whether it is available or pre-booked. The Tickets Vending Machine is in charge of issuing bills and collecting bill amounts [13–15].

When the IR sensor senses of a car, the CCTV camera takes a snapshot and sends it to the MATLAB on the server. When MATLAB recognizes a number plate, it displays the registration plate's text file. As a result, the IN Time is recorded when the picture is detected and the license plate details are recorded. The position of the parking spaces is shown on the screen. The IR points are connected in each slot, and if it detects the presence of an automobile, the condition is changed [16–18].

In pre-booking, the customer comes in using their license plate. The customer books their desired slots, and an OTP is produced for the correct user. The database stores the OTP knowledge for the relevant Number plate as well as the Infrared sensors accountable for the associated slotted content. If the pre-booked IR sensor senses of a vehicle, it alerts the relevant user to input the OTP via the app[19–21].

4. Implementation

This work employs The IR Sensor is utilized to determine whether or not vehicle is present within the specified range. If the IR sensor consists

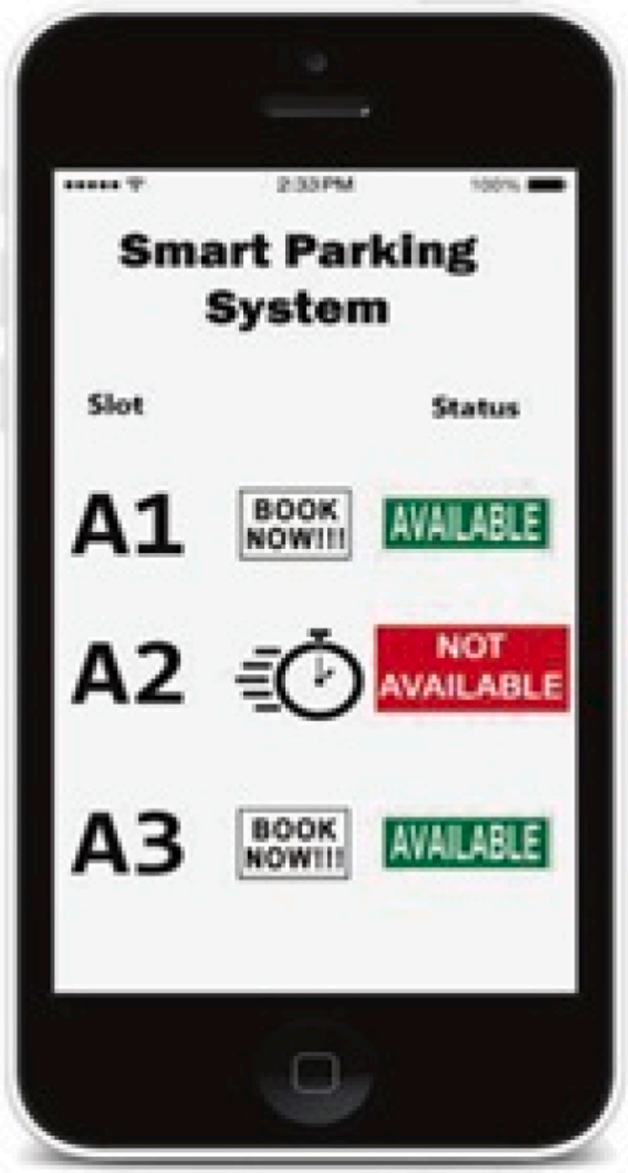

Fig. 5. App screenshot for pre-booking.

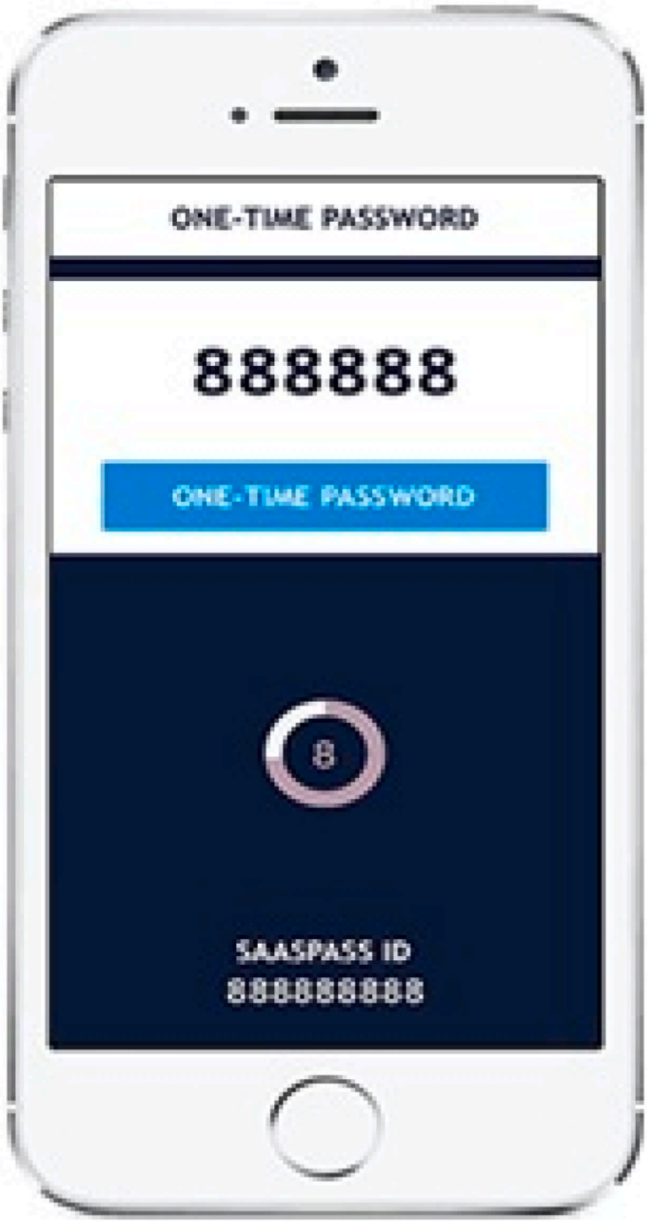

Fig. 6. App screenshot for OTP generation.

of an automobile, CCTV records the image and sends it to MATLAB as insight. The image analysis method is handled via MATLAB. Image Processing extracts the license plate from CCTV photos.

The work is divided into various sections:

1. RGB to Grayscale Image Conversion — the RGB image is transformed to a grayscale.
2. Edge detection — Reduces image data while preserving structural features and detecting registration plates.
3. Morphological Operation - Increase the pixel width from the architectural input of the identified registration number from either the border.
4. Character Segmentation - Each plate's symbols and numbers are separated and stored as separate files R = L/SRP.
5. Template Matching - Compares the distinguished character to the set of data specified.
6. Text file creation- Generates the text document for the number plate.

The database contains a text file including the registration number as

Fig. 7. Sample Matlab performing image processing.

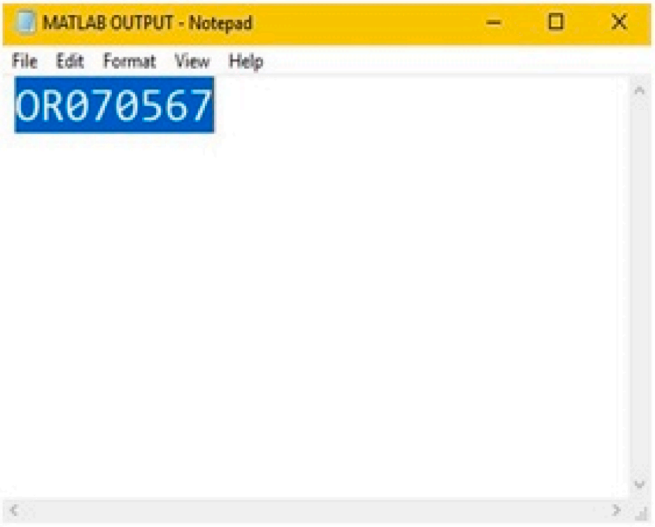

Fig. 8. Sample output text file of Matlab.

well as the accompanying IN time. Every slot has an IR Sensor. It provides the condition of whether or not the vehicle is located in the slot. The slot's state is shown on the monitor screen. In addition, a CCTV camera is installed in the exit doors. The picture of the car is collected and fed into MATLAB. The number plate textual object is generated. When it matches the license plate quantity in the system, the OUT duration is created. The interval from IN and OUT is computed. Based on the charges entered into the application, the bill cost is determined and forwarded to the Tickets Vending Machine. The Tickets Vending Machine outputs the Bill Amount. Each customer can pay with cash using the Automatic Tickets Vending Machine. Following paying the service fee, the car is free to exit the parking space.

The client must connect in to the app using their vehicle's license plate. As a result, each number plate serves as a unique identifier to distinguish users. Each Infrared sensor in the corresponding slots is assigned a unique number. OTP is created when the client pre-booked the slot. The created OTP value is recorded in the system, together with the corresponding IR Sensor identification. The position of scheduled and available automobiles is displayed on a monitor screen next to the parking structure. Once the IR sensor indicates the presence of a vehicle, it prompts the chosen user to enter the OTP. If the OTP corresponds, the car is parked; otherwise, the audible alarm.

4.1. Embedding the sensors

This module contains all of the sensors for the overall network. The system has five detectors: a vibrate detector, an alcohol detection detector, a fuel gauge detector, an eye blink detector, a tire pressure detector, and a GPS system (see Fig. 3).

The tire transducer monitors the pressure created by the air within the rubber. When the differential in airflow exceeds a certain threshold, an alarm is triggered. The fuel gauge device monitors the amount of fuel in the gas tank. Once the gasoline level falls below a set threshold, an alarm sounds to warn the driver. When the seismic sensor detects a pressure greater than the target value, it broadcasts this knowledge, together with necessary information, to neighbors through GSM, signaling an accident has occurred in the specific spot. The program's sensor module and eye gaze sensor evaluate the quality of alcohol by volume in the motorist's blood by evaluating his breathing, while the eyeball blink sensor keeps track of blinks performed by the motorist's eye per 30 s. Every sensor has a maximum bound that, when exceeded, generates an alarm and causes the motor to stop working. In this case, the drive used in the suggested system serves as a complement to the real-time vehicle.

4.2. Communication module

The suggested system's transmitter includes of a GSM system and an IoT. Whenever the detects a barrier as an effect above its corresponding threshold level, the GPS location, time and date, and driver information are communicated to the data store given by the IoT module. Within event of a crash, the seismic sensor's threshold is exceeded, and the data is collected at that precise moment and sent to the cloud server. The GSM module transmits a message to the associated smart phone and any other device that has been authenticated by the network (see Fig. 4).

5. Implementation and discussion

The Iphone for which was before a parking space can be created as indicated in the figure. The user can access the app by entering their license plate number. The application shows the available a slot, after which an OTP is created for the particular user and recorded. When the recipient's user arrives the pre-booked space, it prompts the user to input the OTP (see Figs. 5 and 6).

As seen in Fig. 7, this CCTV Camera Recorded Image is fed into MATLAB as an input Fig. 8 shows how MATLAB executes image analysis and generates a text document of the registration number.

6. Conclusion

In this study, we suggested a system that allows automatic parking spaces without human involvement and pre-booking to save time wasted searching for a private garage. When an automobile is spotted, an image is taken and the associated IN time with the number plate information from MATLAB is saved. When the identical number plate is detected, the Automated Vending Machine calculates the OUT time and generates and calculates the payment request. In Pre-Booking, the client can choose their preferred time slot, as well as an OTP is created for them. All slots have an infrared sensor. Whenever the IR sensor senses of a vehicle, it prompts the people to check the OTP. When both matches are found, the automobile will be parked; otherwise, the alarm will sound. And there is a screen that shows the status of Scheduled and Unbooked slots. The Goal Scope is to execute automated parking inspections of all temperature changes, rain, and any other weather condition. The car's motion can be traced using an Interior Positioning System or Virtual Reality.

CRediT authorship contribution statement

Suthir S: Conceptualization. **Pon Harshavardhanan:** Methodology. **Kavitha Subramani:** Literature Survey. **P. Senthil:** Writing – original draft. **T. Veena:** Software. **Julia Faith S:** Validation. **Nivethitha V:** Supervision, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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