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Internet of Things Based Intelligent Transportation of Food Products During COVID

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Abstract
Transportation management plays a vital role in the development of the country, with the help of IoT smart transportation has become a reality. Developing a smart and secured transportation system of food products to various shops during this pandemic period is an important task. The vehicle tracking system is the technology that is used by many companies and individuals to track a vehicle by using many ways like GPS that operates using satellites and ground-based stations. In this paper an Internet of Things based application is developed to monitor the moving vehicle, this proposed model provides a monitoring solution for a moving vehicle with the help of sensors Blind Spot Assist sensor, Collision Prevention sensor, Fuel Monitoring sensor, Door sensor, and GPS/GPRS tracking module are integrated to make a smart vehicle prototype using raspberry pi. In this model, a Blind spot sensor is used to monitor the nearby vehicles, a Collision Prevision sensor is used to avoid the collision between the vehicles, a Fuel monitoring sensor is used to monitor the fuel level in the vehicle, the Door sensor is used to check the status of the door and GPS/GPRS tracking module is used to track the current location of the moving vehicle during the COVID-19 Pandemic period.

Keywords IoT · Vehicle monitoring · Raspberry Pi · COVID-2019 · GSM/GPRS · Sensors

1 Introduction

The general architecture of IoT consists of a sensor, application, and storage. The sensors are attached to the wireless communication via IoT Gateway which gathers data and sends it to cloud storage. Then data from cloud storage could be displayed using a

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dashboard through the internet. The node sensor contains the processor, power supply, memory, transceiver, and sensors. The processor is implemented as a microcontroller and the power supply ranges from 3.3 to 5 V. Transceiver is mostly used in 2.4 GHz. The usage of IoT has been increasing every year to support different tasks. In 2021, the IoT market is predicted to reach 520 billion USD doubling the number in 2019 and expected to triple by 2025. IoT services can improve productivity and quality of life; they might be sources for cyber-exploitation. Therefore, there is a necessity for coordinated efforts to address those threats and find protection mechanisms [1]. The Internet of Things (IoT) alludes to the joining of the physical world with the advanced world, where objects collaborate and coordinate to give enhanced data, empower better basic leadership, and achieve shared objectives.

The IoT may be used to make sure that customers are correctly affected aware of the maximum suitable/creative form of transportation at any sure time. statistics Mill North's national open transport know the threat to awareness focuses (NaPTAN) provides a momentous label each suggestion driving get right of entry to open shipping in the UK, and are an example of the inspiration on hand now for massive statistics for use with. Plan running affiliations are starting at now utilizing large data to technique live seat transparency facts and display to voyagers paying terrific personality to location ranges which keeps having the maximum chairs reachable. Digital door locks have been widely used lately to enhance security and convenience [2]. A proposed system enhances security by sending images to a user's mobile device. This technique is used to alarm the user when the physical door lock is broken. Another system uses a digital lock system using the Internet of Things (IoT) to provide security for an authorized and a guest user is described. The system allows the owner to provide guest access by capturing a guest picture and send it to the owner for approval. With previous literature, we see that there is an opportunity to protect food during the transition using the IoT technology. Through embedded smart objects securely connected to cloud services, we found a way to gain customer trust as ordered food leave destination. In the following, we explain how we employ technology to serve this goal [3].

Smart transport uses can oversee everyday movement in urban communities utilizing sensors and insightful data preparing frameworks. The fundamental purpose of astute transport systems is to confine action obstructs, ensure basic and trouble-free ceasing, and stay away from mischances by legitimately directing movement and spotting alcoholic drivers. The sensor advances representing these sorts of utilizations are GPS sensors for the area, accelerometers for speed, gyrators forbearing, RFIDs for vehicle recognizing confirmation, infrared sensors for checking voyagers and vehicles, and cameras for recording vehicle advancement and movement [4].

Makers of extremely any kind of gear can use the IoT in about all phases of the assembling procedure. Information on how assets are used inside the office can upgrade fabricating creation plans and enable organizations to better profit by open doors for investment needs or plant changes. Utilizing sensors to gather information can likewise help organizations to benchmark their hardware once it leaves their office. They can log and think about information from hardware in various areas or where gear is set in various working situations and perceive how they perform nearly [5]. This procedure could uncover concealed operational wasteful aspects that would some way or another go undetected until the point that a deadly disappointment happens. In conclusion, producers could use and break down the information they get to offer more suitable deterrent support and guarantee programs. Rather than just getting calls when things turn out badly, sensor information could help producers to get alarms for benefit when something is required, given the execution of the gear leaving the recommended parameters for ideal execution.

The researcher designed an automatic incident detection system using traffic parameters such as distance and time for changing lanes. The experiment was conducted under a numerical simulation environment for the security of fast-moving vehicles. Even though their approach improves the security of the moving vehicle it lags in information process flow and security. The vehicle tracking system is developed using adaptive cellular automata using fuzzy operations for real-time vehicle tracking [6]. It provides security by incorporating different situations to the simulation process but failed to address the various security issues and accuracy. The author's addressed various integration challenges in the transportation system. However, this idea reduces traffic congestion and improves road safety for building an intelligent transportation system. Scientist discussed the impact of functional safety and the development of intelligent transportation systems using service-oriented architectures. The outcome of this approach emphasizes process capability standards and functional safety for reliable transportation but lags in the security and visibility of the system [7].

An automatic incident detection system using traffic parameters such as distance and time for changing lanes is designed. The experiment was conducted under a numerical simulation environment for the security of fast-moving vehicles. Even though their approach improves the security of the moving vehicle it lags in information process flow and security. Researchers developed a vehicle tracking system using adaptive cellular automata using fuzzy operations for real-time vehicle tracking. It provides security by incorporating different situations to the simulation process but failed to address the various security issues and accuracy. Addressed various integration challenges in the transportation system [8]. However, this idea reduces traffic congestion and improves road safety for building an intelligent transportation system.

Researchers developed an intelligent tracking system namely Safe Track for route planning and cargo tracking management using Geo-fencing algorithms and RF techniques. The alerts provided the system to speed up decision-making, possibly reducing losses and costs for the logistics. Even though this approach improves logistics operations, it lags in information flow and security [9]. The author developed a wireless local positioning system for autonomous navigation of transport vehicles. In spite of its speedy delivery and tracking with sufficient coverage and reliability, it failed to address the robustness and accuracy.

A coordinated approach for enabling high-level application development for the Internet of Things is proposed. The primary commitments of this paper are: (1) an improved system that isolates IoT application advanced into various concerns and gives a theoretical structure to build up an application, (2) an advancement system that actualizes the advancement procedure to help activities of partners. This system gives an arrangement of demonstrating dialects to determine every improvement concern and digests the scale and heterogeneity related to unpredictability. It incorporates code age, errand mapping, and connecting systems to give computerization [10]. Code age underpins the application improvement stage by creating a programming structure that enables partners to center around the application rationale, while our mapping and connecting methods together help the sending stage by delivering gadget particular code to bring about a disseminated framework cooperatively facilitated by singular gadgets. The assessment given two sensible situations demonstrates that the utilization of this approach enhances the efficiency of partners engaged with the application advancement.

2 Related Work

Chuang et al. [11] proposed an IoT-based monitoring prototype model for detecting the status of the package during transportation using patch-type piezoelectric sensors. Experiments conducted by them confirmed the reliability of the sensor and viability of the system for real-time detection of damage that occurred to ensure the safety of the package [12]. Li et al. [13] developed a context-aware-oriented vehicle terminal system to enhance the personalized services and automatic management with more accuracy but failed in the invisibility of the system for intelligence digital logistics vehicular management. Lang and Jedermann [14] designed a container management system for logistics in which several sensors and algorithms to estimate temperature-related quality losses are used. It also enhances the security of goods during transportation [15].

Davie [16] developed a Parcel Call approach for real-time tracking and tracing system using short-range intelligent tags. In spite of its limited coverage and reliability, it failed to address the robustness in tracking the vehicle. Zuazola et al. [17] designed a telematics system for the distribution of medicines that tracks vehicles and automatically broadcast the distribution plans between the central office and the vehicle for ensuring safe transportation [18]. Liang et al. [19] developed a cognitive driver distraction system using support vector machines to identify the drivers' eye movement. The experiment was conducted to detect driver's distraction with an average accuracy of 96.1% and ensures secure transportation for goods delivery [20]. Popescu et al. [21] designed an automatic incident detection system using traffic parameters such as distance and time for changing lanes. The experiment was conducted under a numerical simulation environment for the security of fast-moving vehicles. Even though their approach improves the security of the moving vehicle it lags in information process flow and security [22]. Darwish [23] developed a vehicle tracking system using adaptive cellular automata using fuzzy operations for real-time vehicle tracking. It provides security by incorporating different situations into the simulation process but failed to address the various security issues and accuracy. Juan et al. (2015) addressed various integration challenges in the transportation system. However, this idea reduces traffic congestion and improves road safety for building an intelligent transportation system. Ansgar et al. (2015) discussed the impact of functional safety and development of intelligent transportation systems using service-oriented architectures. The outcome of this approach emphasizes process capability standards and functional safety for reliable transportation but lacks in security and visibility of the system [24].

Perumalla and Babu [25] proposed the activity in current urban communities and the urban region is making colossal hazard and is a noteworthy worry for general society and organizational framework. Occurrences, for example, jams, and mishaps have turned out to be very basic on account of exponential development in vehicles on street. While human blunders are one of the significant purposes behind these issues, the absence of appropriate measures and a versatile activity control framework is another reason. Security for the vehicles is likewise critical [26]. Indeed, even in this most recent innovative world, programmers are as yet figuring out how to soften the security viewpoints fused up current vehicles. Numerous advancements, for example, RFID, Bluetooth, Zigbee, GSM-GPS based frameworks were created however they have impediments regarding operation and utilization. IoT, an innovation that associates different items, is developing at a fast pace. This paper presents the activity and vehicle checking framework in view of IoT [27]. This framework is equipped for tending to issues, for example, activity clog, early notices with respect to jams, vehicle spotting, and VIP and crisis vehicle leeway.

Govinda and Saravanaguru [28] clarified every one of the ideas of IoT and the component in a nutshell. The imperative advances which empower IoT are RFID frameworks, Sensor systems, and knowledge advances. The potential uses of these advances are checked on and the significant research issues are portrayed in this paper [29]. Lee et al. [30] proposed another interconnection strategy for productive data partaking in IoT condition considering the informal community. They introduce a strategy and calculation which depends on not just the investigation of the human's informal community yet additionally the thought of the gadget's sociality [31]. At that point, we portray a few situations and actualize the model framework utilizing the situations. A few trials are directed. From the exploratory assessment, they checked that their proposed system is useful in the proficient connection between gadgets with no intercession of people.

Ms. Supriya Chandrakant Padwal and Mr. Suraj Vishnu Kurde (2016) displayed the practical outline and usage of a total WSN stage that can be utilized for a scope of long haul natural checking IoT applications. Their point towards the usage of WSN for condition observing in IoT by recommending answers for different issues confronted while executing WSN in genuine [32].

Aleksandrovičs et al. [33] proposed a rapidly making development today and without a doubt normal thing later on. Different contraptions, handling machines, and work in sensors related in a single dynamic framework diligently get and exchange information from the outside condition [34]. Gigantic data packs are assembled and put to use in great applications that deliberately manage and control given goals. Thusly, an insightful specific structure is made, which can direct, what's more, enter any person's key techniques. Notwithstanding the way that autonomously every contraption and mechanical game plan in the IoT can be known for quite a while, each building is fascinating and gives new difficulties for the framework proprietor. This investigation intends to analyze IoT general structure and organization perspectives with the data of which the makers will attempt to answer a minor inquiry whether it is possible to altogether control such an immense structure with the present level of development [35].

Mhaske et al. [36] utilized packed detecting for IoT applications. Compressive Sensing (CS) as a novel and additionally viable flag change innovation, the main idea to spare the cost of sensors during the time spent transmitting data and get together information. It is conceivable to make independent and net situated applications in IoT [37]. The IoT is a quickly creating territory that has a tremendous extension. Its essential point that of interfacing even the most commonplace items to give an agreeable way of life. They gave a thought that how packed detecting can utilized into information inspecting and securing in remote sensor systems and IoT and furthermore to check mugginess and temperature from nature and furthermore utilized compacted detecting calculation for preparing sensors information.

2.1 Fundamental Qualities of IoT

The principal qualities of the IoT are as per the following:

Interconnectivity: Regarding the IoT, any object can be connected with the overall information and communication establishment.

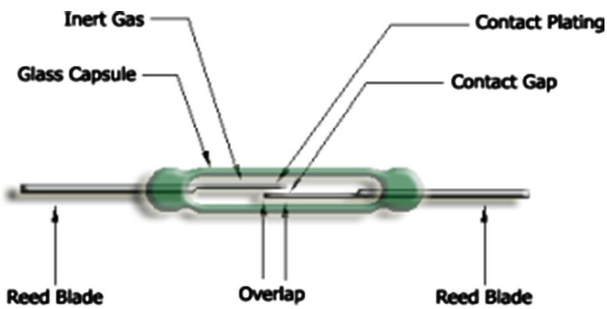
Objects-related managements: The IoT is prepared for giving issue-related organizations within the confinements of objects, as an example, protection confirmation and semantic reliability among real matters and their connected [38, 39].

Imaginary matters: Remembering the proper objective to provide component-related companies inside the requirements of things, each the progressions in bodily global and statistics world will trade [40, 41].
Heterogeneity: The gadgets in the IoT are different objects as in perspective of different equipment tiers and frameworks. They might work together with numerous gadgets or enterprise arranges by different frameworks [42, 43].
Dynamic changes: The state of contraptions replace continuously, e.g., sitting as well as arousing, related or conceivably split and furthermore the setting of devices adding region and pace. Furthermore, the amount of contraptions can modify capably [43, 44].
Immense scale: the quantity of devices which have to be directed and that communicate with together may be no longer as plenty as a call for of degree extra than the devices related along the existing internet. Considerably extra simple can be the management of the facts produced and their translation for software purposes. This identifies with semantics of statistics, and additionally productive data taking care of [45].
Wellbeing: As we choose up earnings by way of the IoT, we must now not push aside security. As each the manufacturers and recipients of the IoT, we need to define for wellness. This includes the wellness of our own facts and the security of our physical affluence. Securing the endpoints, the systems, and the records shifting over each closing little bit of it hints creating a safety worldview so one can scale [46].
Availability: Connectivity allows prepare directness and resemblance. Availability is receiving on a device while resemblance offers the regular capability to dissipate and create records [47].

3 Proposed Model to Monitor Goods Carrying Vehicle during COVID-19

In this paper, the proposed model to monitor goods carrying vehicles is proposed for secure delivery of the goods to the different during the COVID-19 pandemic. The monitoring of the vehicle contains two main parts. The first one is an automated locking system and the second one is the monitoring of the vehicle. To provide a better experience to the user both these systems can be accessed on a mobile phone using the Internet of Things. Figure 1 shows Reed Switch Sensor.

Fig. 1 Reed Switch Sensor



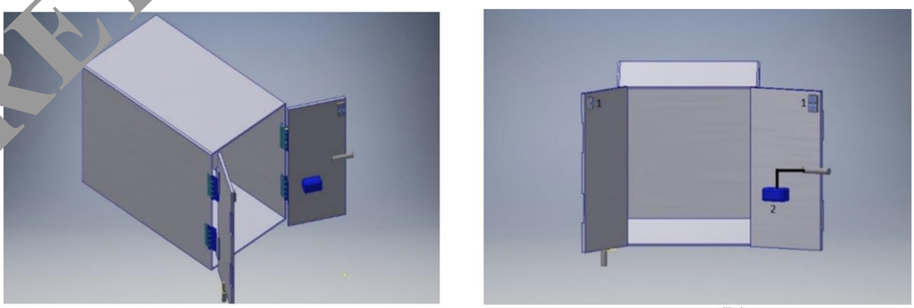
3.1 Automated Locking System

The dimension of food products carrying vehicle is 250 × 160 × 145 cm^3 is simulated using the ratio of 1:7 prototype model. The prototype dimension is 36.2 × 23.4 × 20.4 cm^3. In this paper, the automated locking system is developed for food product carrying vehicles using servo motor has an IoT based slot drive. This model can automatically lock and unlock the door and further, it can monitor the state of the door remotely to provide security for the user. The control and monitoring process of vehicle boxes can be done via an android application using the Internet of Things. The reed switch sensor installed at the door of the vehicle can monitor the state of the door vehicle in real-time. If the vehicle box is opened the reed sensor will send the notification to the android application which has been installed on the phone. By using this model food products can be delivered safely during the COVID-19 time. Figure 2 represents the Delivery vehicle Prototype (a) Top-view (b) Front-view.

Figure (b) shows the installation of the servo motor and the reed switch sensor. The sensor is like an electrical switch that can be used by applying the magnetic field. The sensor works on the principle of 0 and 1 binary logic. If the magnet and sensor on the door of the vehicle are closed then the logic of the sensor is 1 which means the door of the vehicle is closed. In case, the magnet and sensor are apart then the logic of the sensor is 0 which means the door is open.

3.2 Automated Vehicle Monitoring System

In an Internet of Things based automatic vehicle monitoring system, communication among the various elements is automated in a smart fashion. The warehouse provides details about the food products in the vehicle and details of the place where the food product has to be delivered. Since the trucks play important role in the transportation of food products, this paper provides the solution in monitoring the vehicle using the Sensors. Blind Spot Assist sensor, Collision Prevention sensor, Fuel Monitoring sensor, Door Sensor, and GPS/GPRS tracking module are integrated to make a smart lorry prototype using raspberry pi. In this model, a Blind spot sensor is used to monitor the nearby vehicles, a Collision Prevision sensor is used to avoid the collision between the vehicles, a Fuel monitoring sensor is used to monitor the fuel level in the vehicle, the Door sensor is used to check the status of the door and GPS/GPRS tracking module is used to track the current



(a) (b)

Fig. 2 Delivery vehicle Prototype **a** Top-view **b** Front-view location of the moving vehicle. Figure 3 depicts the Schematic Representation of Automated Vehicle Monitoring System.

3.2.1 Data Generation

The three different kinds of sensors are attached to the vehicle and the sensors are made active to sense their individual tasks. Once the vehicle starts to move the status of the sensors are recorded in the binary format 0 or 1. The 0 indicates normal status and the 1 indicates the abnormal status. Figure 4 represents Data Generation from the Vehicle Prototype.

3.2.2 Data Encryption Using Paillier Homomorphic Cryptography System

The data generated during the moving of vehicle is encrypted using Paillier homomorphic cryptography system and stored in the cloud to monitor the vehicle using application. In the encryption process, the system encrypts the plain text using the public key. Let $m \in Y_N$ be the plain text and the random number used for encryption is $n \in Y_N^*$. With the help of isomorphic the cipher text can be obtained. Figure 5 shows the Data Encryption using PHCS.

3.2.3 Report Generation

The sensor data reflected in the developed application is decrypted by the warehouse administrator using PHCS decryption algorithm and the same is used for analyzing purposes using the Map Reduce programming model. Based on the previous transportation histories the analysis is performed and prediction report is given to the driver before the transportation is carried out. Figure 6 represents Report Generation.

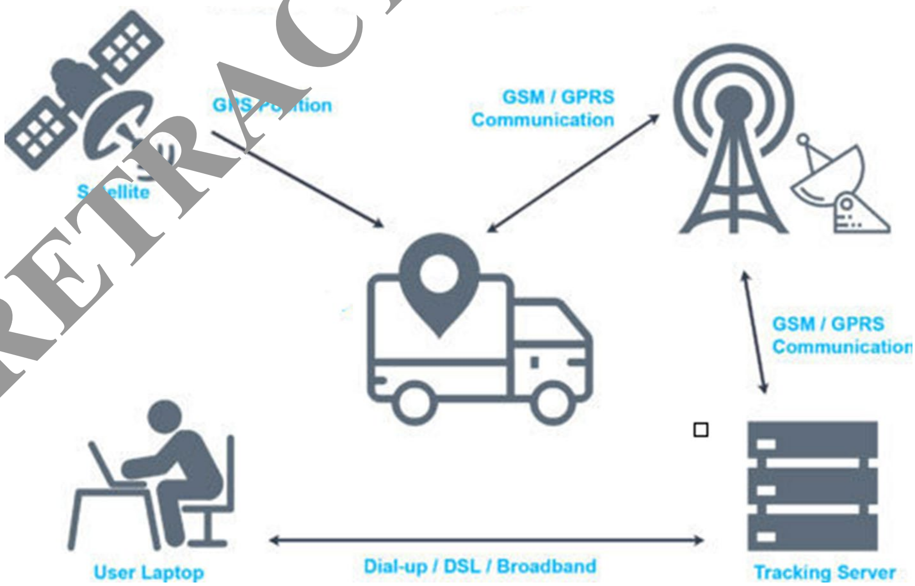


Fig. 3 Schematic Representation of Automated Vehicle Monitoring System

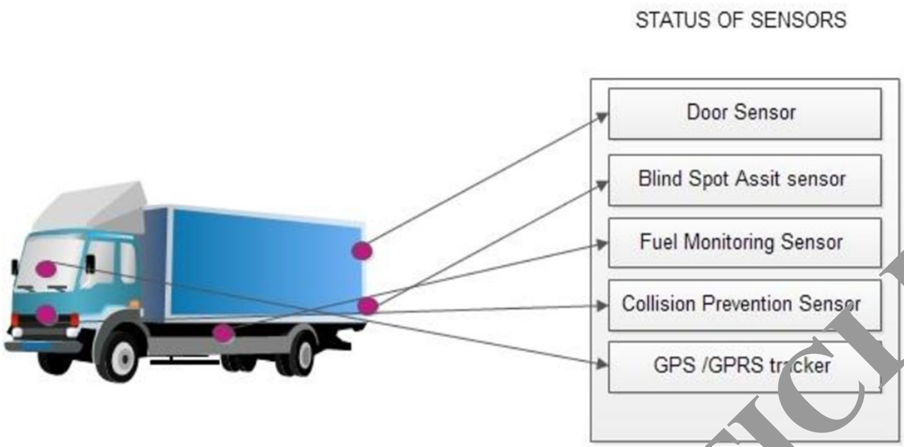


Fig. 4 Data Generation from the Vehicle Prototype

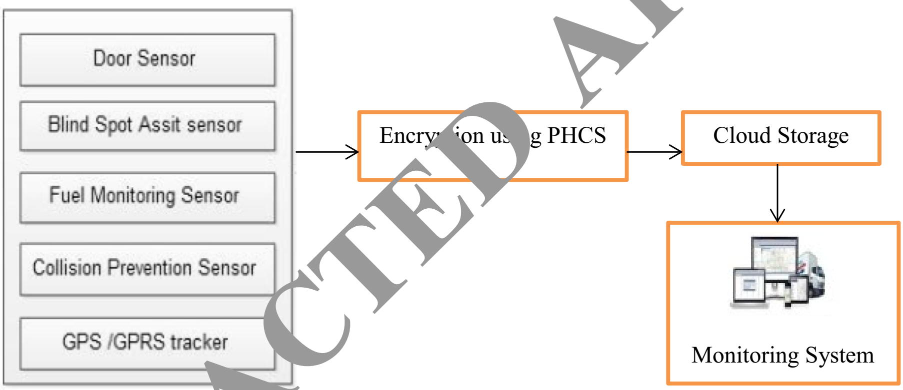


Fig. 5 Data Encryption using PHCS

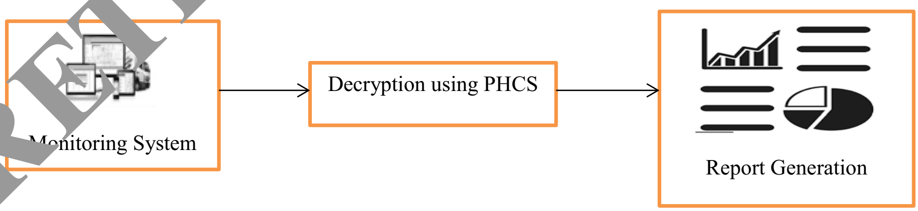


Fig. 6 Report Generation

4 Design of the Automated Vehicle Monitoring System

Components used for this model development are Raspberry Pi 3 module, Ultrasonic sensor, IR sensor, fuel level sensor, Transistor, Resistor, Diode, DC Voltage regulator, Relay, Capacitor with 1000uf, Battery 12 V, LCD display 16*2, DC gear motor with 12 V with 60 RPM, Pushbutton capacitor, GSM SIM800A.

and PIC16f877 Microcontroller. The LCD display is used to show the status of.

the sensors in the model. The 12 V battery is used to send power supply to all the.

components and the alarm is raised in case any problem occurs. Figure 7 shows the Various Sensors Attached to the Raspberry-Pi.

When the model is switched on, the battery provides the necessary power supply to all the components and the motor helps to move the prototype model either forward or backward direction. In the proposed model, the Door sensor is used to monitor the status of the backside door. The Reed Switch is used for door status monitoring. The ultrasonic sensor is used to prevent the collision of the prototype with other obstacles. It includes an ultrasonic transmitter, receiver, and control circuit. The input voltage of the module is 5 V and its operating frequency is 40 kHz. The distance is computed using the equation,

$$\text{Distance} = (time * speed)/2 \tag{1}$$

Once the obstacle is found then automatically the speed of the model is reduced and finally the engine is stopped within a limited distance. The Blind Spot detection sensor is used to detect the nearby vehicles that come closer to the model in a reasonable time. The operating voltage of this sensor is 6–12Vand it measures a distance up to 8 m. The distance is computed using

$$Dis = (high\ level\ time\ *\ sound\ velocity(340\ m/s))/2 \tag{2}$$

Once a vehicle is identified by the blind spot detection sensor in a reasonable time then automatically the alert is given to the driver using an alarm. The Fuel Monitoring sensor is used to monitor the fuel level in SLPM. The main purpose of this sensor is to monitor the level of the fuel during transportation and to alert the driver when fuel level goes beyond the minimum level.

5 Mechanism for Encryption and Decryption of Data generated

The PHCS is used in the proposed model for key generation, encryption, and decryption. The data generated from the moving vehicle is encrypted using the PHCS algorithm and stored in the cloud database. The Administrator decrypts the data from the

Fig. 7 Various Sensors Attached to the Raspberry-Pi

cloud PHCS decryption algorithm and views the current status of the moving vehicle via mobile application.

The working process of PHCS algorithm in key generation, data encryption and decryption is given below,

5.1 Key Generation

When the cloud user creates an account, it sends a request to the key management server. This requests the certification authority to provide the certificate. Based upon this certification key it generates a key using its algorithm, split that key and store it on different cloud storage. The PHCS creates a both keys for encryption and decryption. For key generation, it uses two prime numbers. The steps for key generation is given below,

Algorithm for Key Generation

Step 1: choose any two different odd prime numbers of same size and assign them as a and b.

Step 2: calculate X=a,b and the function on x is φ (X) = [(a-1) (b-1)]

Step 3: Confirm the following,

Step3.1: The combined value of gcd(X, φ (X) =1.

Step 3.2: For all Value of a>0, $(1+X)^a = (1+aX) \bmod X^2$.

Step 3.3: The order of $(1+X) \in Y_N^{*2}$ for all value of 1< a < j.

Step 4: A random number is selected, [illegible] $\in Y_N^*$.

Step 5: Return X, (X, φ (X)) and [illegible] of the system.

5.2 Encryption

The second process of the PHCS is the encryption process, the system encrypts the plain text using the public key. Let $m \in Y_N$ be the plain text and the random number used for encryption is $n \in Y_N^*$. with the help of isomorphic the cipher text can be obtained from the below formula,

Step1: $Y_N \times Y_N^* \rightarrow Y_N^{*2}$

Step 2: Cipher text = E (mmod X, nmod X) = k(m,n).

5.3 Decryption

The last part of the PHCS system is the decryption process, the plain text can be obtained from the cipher text using the private key X, φ (X). the process of the decryption is given below,

Step1: Set cipher text $\hat{c} = [c^{\varphi(n)} \bmod X^2]$, where c is the plain text

Step 2: $\hat{m} = (\hat{c} - 1)/X$.

Step 3: After the decryption process, the plain text obtained is $m = [\hat{m}.\ \varphi(X)^{-1} \bmod X^2]$.

5.4 Report Generation

The data generated from the moving vehicle is stored in the form of histories. The histories have different entries like latitude, longitude, distance covered, and status of the removing vehicle. The algorithm to generate the report is given below,

Algorithm for Report Generation

Input: sensor status

Output: display occurrence of sensor status with their latitude and longitude

SET Sensor Status as SS

SET Normal Status as NSS

SET Abnormal Status as ASS

SET Latitude and Longitude as LL

SET Count of Sensor Status as CSS

Begin

Class Mapper

Map (<<int>>SS<<float>>LL {

if (SS==0) display NSS

else

display ASS with LL

}

Class Reducer

Reduce (<<int>>ASS<<float>>LL) {

display CSS with LL

}

The Map-reduce is used to find the status of the moving vehicle and their respective latitude and longitude value. If the value of the sensor is 0, then the vehicle movies in the normal condition and if the sensor status is 1 then the vehicle is in an abnormal condition, if it’s in abnormal condition then the status of the vehicle with their respective latitude and longitude values are displayed. The Map-reduce algorithm counts the number of the abnormal condition occurred and their latitude and longitude values in form of a report.

6 Results and Discussions

This section discusses the experiments carried out to validate the developed hardware model and the designed IoT application to track and monitor the hardware. This developed Prototype Model is executed to check the operations of different attached sensors and to make sure of the correctness of data collected.

6.1 Door Sensor

The purpose of the door sensor is to monitor whether the backside door of the lorry is open either by road condition or by unauthorized persons. The former is brought into the experiment by creating different kinds of roads for vehicle movement viz., normal, path hole and gravel whereas later by manual hitting and unlocking. the door sensor is executed using the developed hardware model in the prescribed path. The values of time, status of the door, and latitude and longitude values are recorded. Table 1depicts Sensed Information of Door Sensor.

6.2 Collision Prevention Sensor

This sensor is installed to protect the goods carrying vehicle from colliding with the obstacles. To prevent collision of vehicle ultrasonic sensor is used for sensing the obstacle present in the determined path. The Ultrasonic sensor produces the ultrasonic sound to find the obstacle present in the path, if the obstacle is found in the described path the vehicle is instructed to stop and instruct the vehicle to select the alternate path. to test working of the model obstacle are placed in the road and allowed to travel around 500 m, the sensor computes the distance using the formula (1), if the distance measured is more than 500 m then the vehicle will move as usual, but the proposed model gives an alarm when the covered

Table 1 Sensed Information of Door Sensor

S.No	Time in HRS	Time in MINS	Time in SEC	Latitude	Longitude	Distance (m)	Door Status
1	04	00.05	00.05	89	67	50	Door Closed
2	04	00.05	00.15	89	67	100	Door Closed
3	04	00.05	00.25	89	67	150	Door Closed
4	04	00.05	00.35	89	67	200	Door Closed
5	04	00.05	00.45	89	67	250	Door Closed
6	04	00.05	00.55	89	67	300	Door Closed
7	05	00.06	00.05	89	67	350	Door Closed
8	05	00.06	00.15	89	67	400	Door Closed
9	05	00.06	00.25	89	67	450	Door Closed
10	05	00.06	00.35	89	67	500	Door Open

Table 2 Sensed Information using Collision Prevention Sensor

S.no	Time in HRS	Time in MINS	Time in SEC	Latitude	Longitude	Distance (m)	Status
1	07	00.05	00.05	93	77	50	No Obstacle
2	07	00.05	00.15	93	77	100	No Obstacle
3	07	00.05	00.25	93	77	150	No Obstacle
4	07	00.05	00.35	93	77	200	No Obstacle
5	07	00.05	00.45	93	77	250	No Obstacle
6	07	00.05	00.55	93	77	300	No Obstacle
7	08	00.06	00.05	93	77	350	No Obstacle
8	08	00.06	00.15	93	77	400	No Obstacle
9	08	00.06	00.25	93	77	450	No Obstacle
10	08	00.06	00.35	93	77	500	Obstacle Found

distance is above 500 m. Table 2 depicts Sensed Information using Collision Prevention Sensor.

The execution of the ultrasonic sensor is done by running the hardware tool on the prescribed path. The obtained results are shown in the above table, if the obstacle is found the proposed model chooses the alternate path for transmission of food products. The data generated of moving vehicles after choosing the alternate path is tabulated below. Table 3 depicts the Sensed Information of Collision Prevention Sensor after Selecting Alternate Path.

6.3 Fuel Sensor

The fuel sensor is used to monitor the level of fuel present in the moving vehicle while food products transmission. To evaluate the working of this sensor, an alternate fuel tank is added to the vehicle with the fuel monitoring sensor to monitor the level of fuel at a different distance. The fuel capacity of the artificial tank is 1000 ml and the sensor

Table 3 Sensed Information of Collision Prevention Sensor after Selecting Alternate Path

S.no	Time in HRS	Time in MINS	Time in SEC	Latitude	Longitude	Distance (m)	Status
1	09	00.05	00.05	55	69	50	No Obstacle
2	09	00.05	00.15	55	69	100	No Obstacle
3	09	00.05	00.25	55	69	150	No Obstacle
4	09	00.05	00.35	55	69	200	No Obstacle
5	09	00.05	00.45	55	69	250	No Obstacle
6	09	00.05	00.55	55	69	300	No Obstacle
7	10	00.06	00.05	55	69	350	No Obstacle
8	10	00.06	00.15	55	69	400	No Obstacle
9	10	00.06	00.25	55	69	450	No Obstacle
10	10	00.06	00.35	55	69	500	Alternate Path Selected

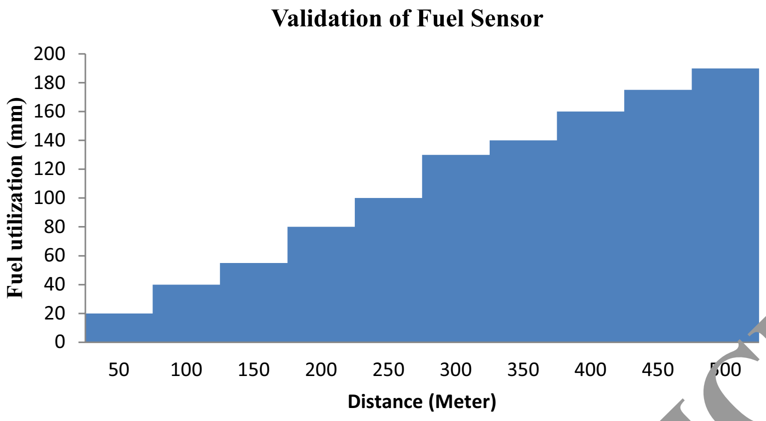


Fig. 8 Validation of Fuel Sensor

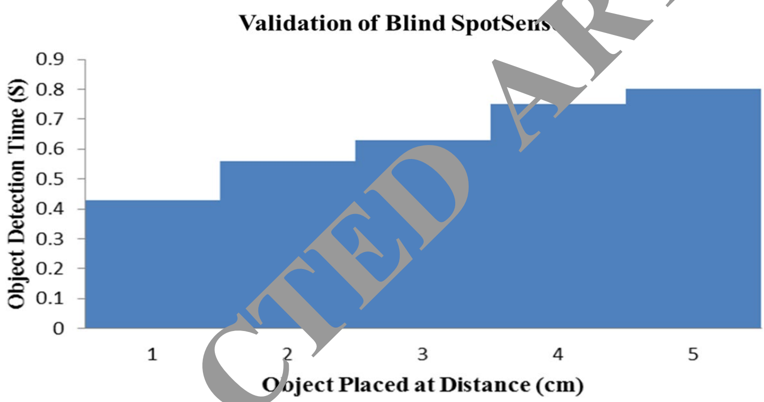


Fig. 9 Validation of the Blind Spot Detection Sensor

monitors the level of the fuel, if the level of the fuel goes beyond 250 ml alert is given to the driver using the alarm. Figure 8 represents Validation of Fuel Sensor.

.4 Blind Spot detection Sensor

This blind spot detection sensor is used in this prototype to protect the moving vehicle from the unauthorized persons who follow the moving vehicle at the regular interval of time. The validation of blind spot detection is done by placing the blind spot at the backside of the prototype. The camera fixed at the back side of the vehicle is used to record the vehicle that comes nearer to proposed model by computing distance between proposed model and the vehicle using the Eq. 2.If the sensed distance is more than 500 cm, then the status is normal but it gives out alarm to alert the driver when the

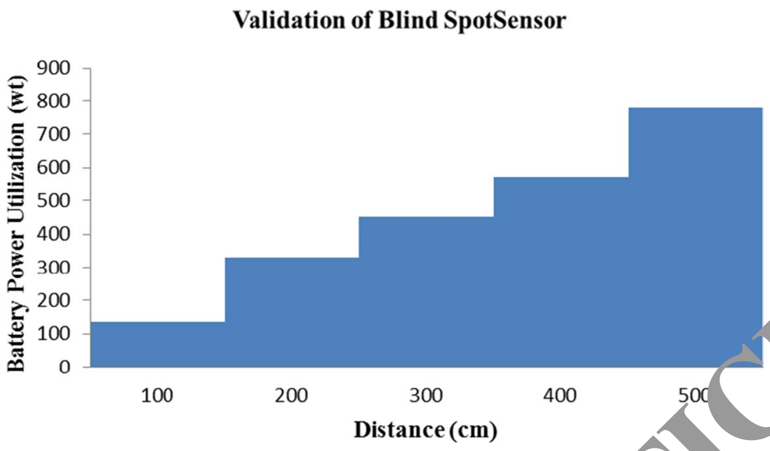


Fig. 10 Validation of the battery Utilization Sensor

Table 4 Time Taken to Process the Histories

S. no	Number of Histories	Map Reduce Processing Time (Ms)
1	500	3567
2	1000	4786
3	1500	6896
4	2000	8761
5	2500	9675
6	3000	10,678
7	3500	11,964
8	4000	12,765
9	4500	13,998
10	5000	14,001

sensed distance between the blind spot and the following vehicle is less than 500 cm. Figure 9 represents the Validation of the Blind Spot Detection Sensor.

6.5 Validation of Battery Utilization

The battery consumption of the proposed model is tested by running the hardware in the described path, the utilization of battery power is recorded separately and displayed, the maximum capacity of the battery used in the prototype is 12 V i.e., 1800 W energy. Figure 10 shows the Validation of the battery Utilization Sensor.

6.6 Processing Time

The proposed model is executed and the status of the sensors is recorded and stored in the form of histories. The recorded histories are analyzed and the prediction report is generated using the Map-reduce model. The time taken for processing the histories is tabulated below in Table 4,

7 Conclusion

In the proposed system, we aim to enhance the food delivery service using IoT by increasing safety and quality. The digital lock system here provides security and eliminates human contact. This proposed model provides a monitoring solution for a moving vehicle with the help of sensors like a Door sensor, collision prevention sensor, Fuel monitoring sensor, and battery utilization sensor. The data generated from the various sensors are stored and monitored. If there is an abnormal condition during moving the driver is alerted with an alarm, during vehicle movement data is generated and the generated data is encrypted using the PHCS algorithm and stored in the cloud for vehicle monitoring. The status of all sensors is formed as a data set and used for the analysis using the Map Reduce programming model. The prediction report is generated in a minimum time based on previous transportation histories. The efficiency of the proposed model is validated by using it in different kinds of experiments. From the above-obtained results, the proposed model delivers the food products in a safe and secured manner during the COVID-19 pandemic. In our future work, we will implement the artifact in a real-world scenario and do a thorough evaluation and how it will impact community and food industry standards.

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Availability of Data and Material (Data Transparency) Based on the request.

Declarations

Conflict of interest The author declares that they no conflict of interest. The author of this research acknowledges that they are not involved in any financial interest.

Consent to participate Author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before. Furthermore, Author certifies that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript.

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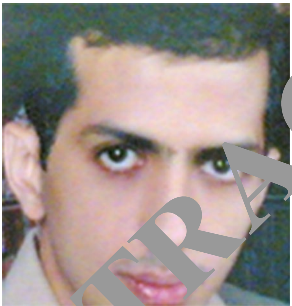

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