Secured College Bus Management System using IoT for Covid-19 Pandemic Situation

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Abstract— College bus transportation system plays a vital role in students' life. They provide safe and secured journey compared to other mode of transportation. The current COVID-19 pandemic situation has driven the State Governments and all the college authorities around India to enforce limitations on transportation and movement of students in order to prevent the spread of disease. But taking the students education into considerations, many state governments have advised to open the colleges with proper precautionary measures. However, student health has to be given more importance as they are the backbone of the country. So, a Secured College Bus Management System (SCBMS) has been introduced which monitors the health of the student and the safety measures followed by the student before entering into the bus. Alert information will be passed to the parent and the college management if a person fails to cross these two stages of screening process. Vehicle location information is passed to the parents periodically in order to prepare their child for the school on scheduled time before the bus reaches their boarding point. College bus attendance is monitored efficiently and updated to college authorities for further actions.

Keywords— *Secured College Bus Management System, Internet of Things (IoT), Smart transport system, GPS, Cloud Server.*

I. INTRODUCTION

Internet of Things (IoT) is a group of physical entities with sensors that are connected togeather through an infrastructure called Internet. as of now nearly there are 31 billion devices that are connected to Internet and by 2025 there would be nearly 75.44 billion IoT devices [11] . Currently IoT has its impact in numerous fields like agriculture [12,13], transportation, logistics, , industries [14,15]and many more[16] . Figure 1 explains the domination of IoT in various fields. Publicly known IoT platform has increased 2.4 times within the span of 4 years between 2015 to 2019 which is

depicted in the figure 2 [16]. Totally IoT helps the humans to lead their life in a smarter way.
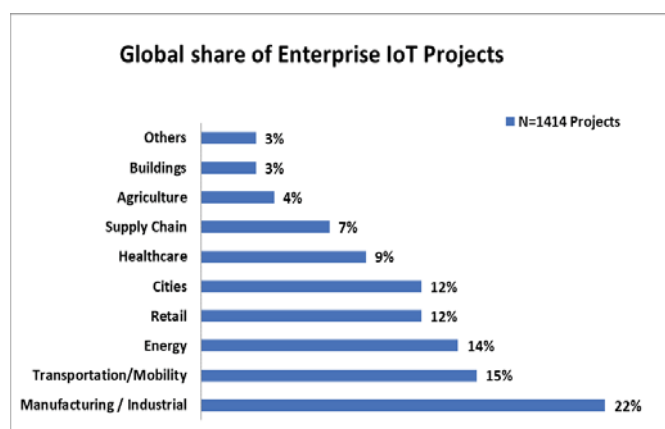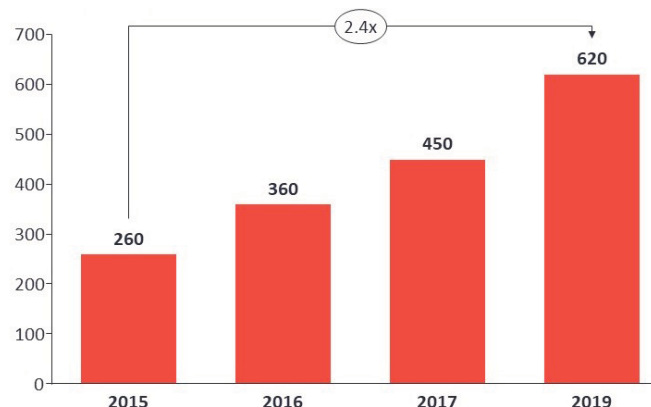

Fig1: Global share of Enterprise IoT Projects

Fig 2: Number of Publicly known IoT platforms

The current Covid-19 pandemic situation has created an intimidating challenge to all countries. India currently ranks second in terms of population and it is found to 1,371,360,350 [1]. India holds nearly one sixth of the total population of the world. India has produced nearly 12% of the global graduates in 2020 [2] which is depicted in figure 3.
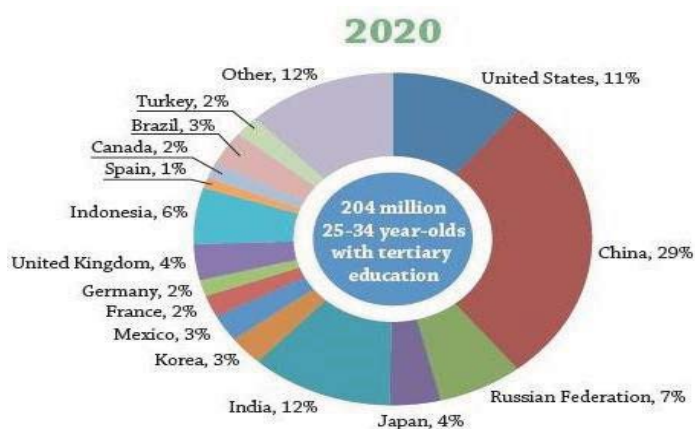

Fig.3: Global graduates' percentage in 2020

Since India is producing a huge quantity of graduates, they are treated as pillars of our nation. Hence it is important for us to prevent them from this Covid-19 pandemic situation. This factor has driven the State Governments and all the college authorities around India to enforce limitations on transportation and movement of students from March 2020 in order to prevent the spread of disease. However, taking student future into consideration many State Governments has insisted the colleges to function normally with proper precautionary measures. Even though the precautionary measures are being followed in college premises, there is a huge possibility of Covid-19 disease spread during the bus travel. In order to eradicate this issue, a Secured College Bus Management System (SCBMS) has been proposed. The main objective of our system is to provide the following features

- It monitors the health condition of the students, by analyzing the temperature of the students using IR temperature sensor.
- It monitors the usage of mask by the students using Open Computer Vision technology
- It monitors the attendance of the bus and updates to college authorities
- It frequently updates the bus location through SMS before the bus reaches the boarding point

II. RELATED WORKS

Vinoth Kumar et al [3] proposed Smart public transport system which uses Android Application to book the tickets through online mode and sends the bus location details to passengers on their request. Vigneshwaran et al [4] proposed IoT based Bus tracking and Fuel monitoring system which monitors the bus route and updates it to the authorities. In addition to it monitors the fuel quantity and provides alert message to the authorities. The students can also track the bus location using the GPS facility available in the system. Majid

et al [5] proposed a smart bus technology which uses GPS to track the location of the bus and intimate the location of the bus to parents on demand basis through SMS with the help of GSM technology. Similar type of work is carried out by Sridevi et al [17]. Emad Badawy et.al [18] proposed an IoT based smart transport system which monitors the comfort level of the students by evaluating the temperature and moisture level inside the bus and updates the data to the cloud server, so that the authorities and parents can update the status of the child at any time. In addition to comfort level monitoring, they have introduced attendance monitoring scheme. Sharmin Akter et.al [19] introduced Bus Tracking System using IoT, which monitors the location of the bus and seat availability in the bus. This method helps in reducing the waiting time of the passengers at the bus stop. Madhura Inamdar et.al [20] proposed a deep learning-based face mask detection technique which is used to detect the people without face mask at various public places with the accuracy of 98.6%

Yaoyao et al [6] proposed a GPS based vehicle monitoring system which updates the location and safety condition of the vehicles to the authorities. Ciya James et al [7] proposed a Open Computer Vision technology based image recognition for students attendance monitoring in college bus. Judy Thyparampil Raj [8] proposed an IoT based bus tracking system which sends the location of the bus to the parents before the bus reaches the boarding point and it also uses RFID technology to monitor the attendance in the bus and updates it in the cloud server. Sanam et at [9] proposed a smart E-Ticketing system which is used to check the seat availability and book the ticket through online mode. Cemil Sungur et al [10] proposed a passenger information system using which the passenger can find out the estimated time to reach the destination during the travel.

III. PROPOSED SYSTEM

The overall architecture is depicted using figure 4. Here Raspberry-pi receives the students detail using RFID reader. Once the student details are recognized, the camera fetches the student's face and sends it to Open Computer Vision, which compares the current image with the trained image in order to identify whether the student wears the mask or not. Our system also monitors the temperature of the student using IR temperature sensor and compares the temperature with threshold temperature. If the temperature is found to less than the threshold value, the bus door is opened for the students to enter into the bus. After the two stages of screening, the student is allowed to enter into the bus. Hence our system provides safety for the students those who are travelling in the college bus. Raspberry-Pi sends the data to Cloud server for updating the website. If a student fails to wear a mask or if the student temperature exceeds the threshold value, then the server sends the message to the Parent. The college authorities can also monitor the status of the attendance in the website. Our system is also connected with GPS which sends the location of the bus periodically to the parent until the bus reaches the boarding point of the student.

Table 1: Comparison of proposed system

| Author Name	Title	Updates bus location details	Updates Attendance	Students health (Temperature) monitoring	Face mask detection
Vinoth Kumar et.al [3]	A smart public transportation system for reliable and hassle free conveyance in sustainable smart cities	Yes	Yes	No	No
Vigneshwaran et.al [4]	Design of Bus Tracking and Fuel Monitoring System	Yes	No	No	No
Majid et.al [5]	Smart bus: A tracking system for school buses	Yes	No	No	No
Sridevi et.al [17]	Smart Bus Tracking and Management System Using IoT	Yes	No	No	No
Badawy et.al [18]	An IoT based School Bus Tracking and Monitoring System	Yes	Yes	No	No
Sharmin Akter et.al [19]	A Cloud-Based Bus Tracking System Based on Internet-of-Things Technology	Yes	No	No	No
Madhura Inamdar et.al [20]	Real-Time Face Mask Identification Using Facemasknet Deep Learning Network	No	No	No	Yes
Yaoyao et.al [6]	A hazmat transportation monitoring system based on Global Positioning System / Beidou Navigation Satellite System and RS485 bus	Yes	No	No	No
Ciya James et al [7]	Student Monitoring System for School Bus Using Facial Recognition	Yes	Yes	No	No
Judy Thyparampil Raj [8]	IoT based smart school bus monitoring and notification system	No	Yes	No	No
Cemil Sungur et.al [10]	Smart Bus Station-Passenger Information System	Yes	No	No	No
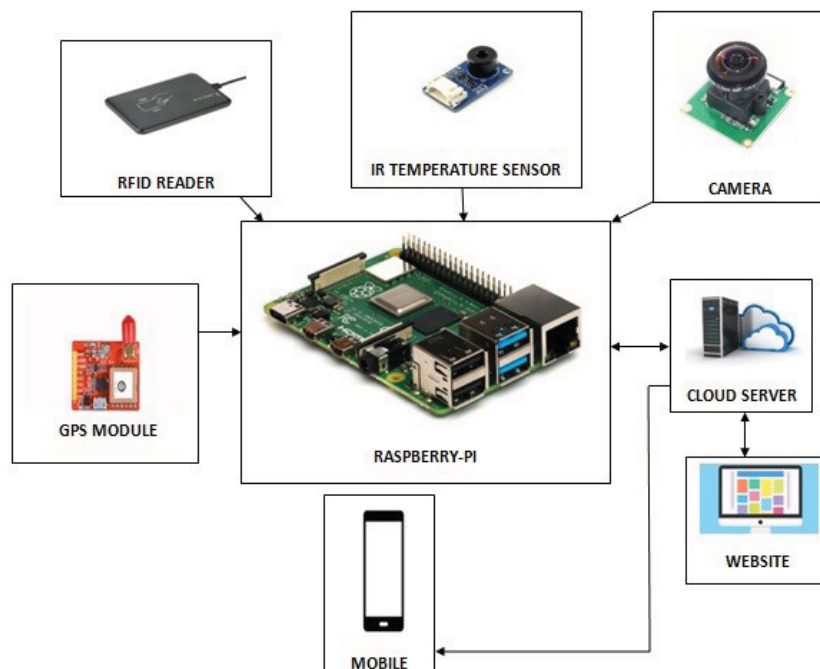
Fig. 4: System Architecture
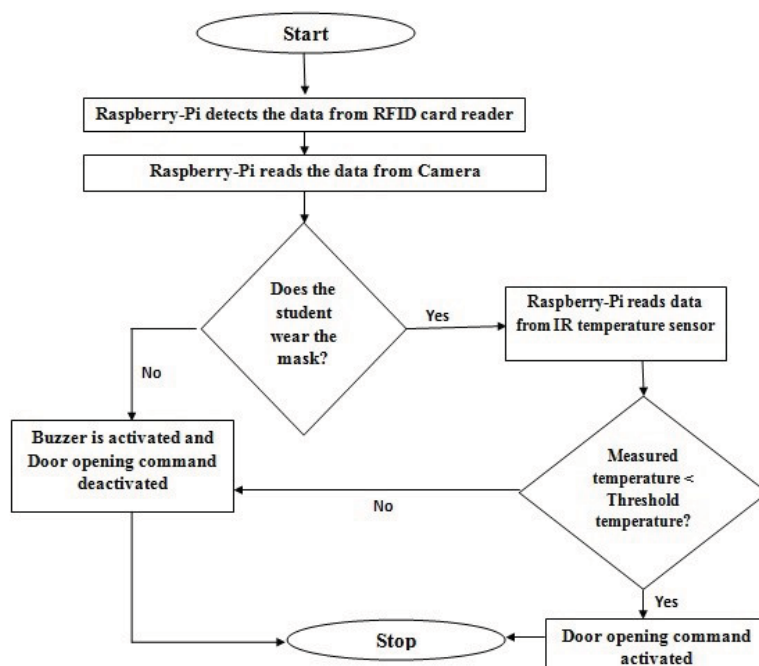
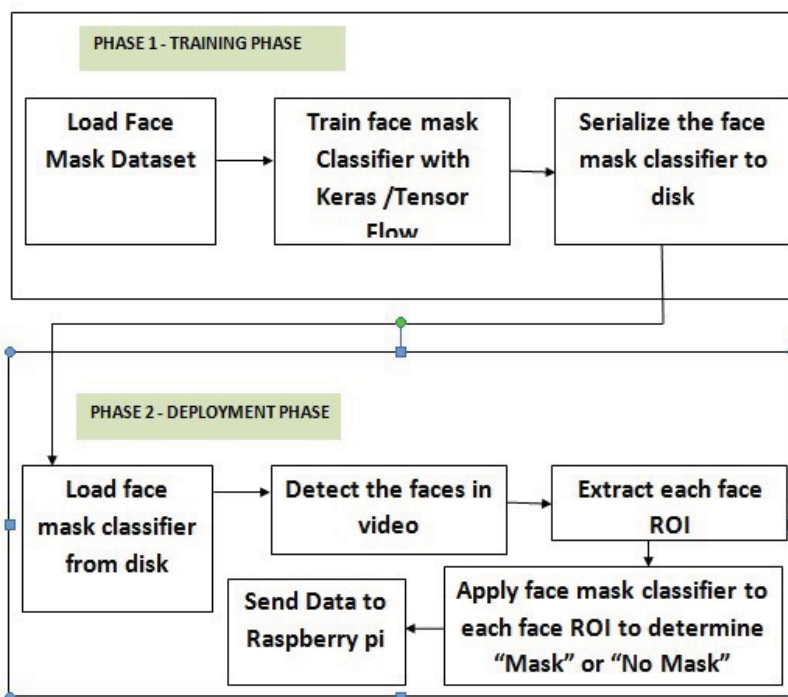**Fig. 5: Flow Chart for Automatic bus door opening process**

Fig.6: COVID19 mask detection process

A precautionary message regarding the safety measures to be followed in the bus will also be sent to the parent before the bus reaches the boarding point of the student. The Automatic bus door opening process is explained using a flow diagram mentioned in figure 5. Whenever a student enters in to the college bus, he needs to swipe the access card, then the system permits the students to enter in to the bus after the covid19 screening. The system is implemented using raspberry pi which runs on Broadcom processor with 4GB RAM. The while system is implemented as a kiosk (Stand) at both the entrance of the bus. The automatic door opening process is explained using following steps

**Step 1:** Raspberry-pi fetches the data from RFID reader.
Step 2: After checking the student's detail, the Raspberry-pi gets the data from the camera.

Step 3: The captured image is compared with the trained image. Then the processor proceeds to next step if the student is found to be wearing the mask or else the door will not be opened for the student to enter into the bus.

Step 4: Now the Raspberry-pi receives the data from IR temperature sensor. If the obtained temperature is found to be less than the threshold temperature, then the bus door will be opened for the student to enter into the college bus or else it will not open the bus door and it also activates the buzzer to alert the bus in charge.

Mask identification process takes place in two phases which is explained in figure 6. The ultimate part in this proposed system is to detect whether the students are wearing the mask while entering into the college bus. This process is carried out in the raspberry pi which runs on a Broadcom processor and with 4GB RAM.
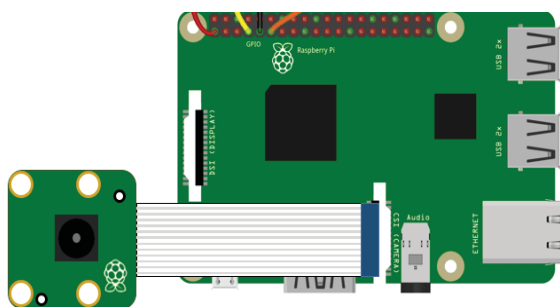
Fig.7: System Setup for Covid19 mask detection

In the initial phase the tensor flow based Deep neural networks identifies whether the student is wearing mask or not. The system is made robust which is done by training the system with multiple variations of images with mask and without mask in order to avoid false positives.

These operations were done in two phases; the phase one is the training phase in which hundreds of images which includes the faces with and without masks were given as an input to the training phase which is trained using Tensor flow. The next phase is the deployment phase which performs the face detection operation and classifies the given input image is with mask or without mask.

This proposed system consist of 1456 datasets of which 786 images are the faces with mask and the remaining 670 images are faces without mask. Once the images are trained with this dataset it will be presented with a test data through a image or live video stream. First it detects the face from the video stream and then the system detects the region of interest from the video stream. Now the MobileNetV2 classifier is applied on the Region of Interest to detect the test image is with mask or without mask. The algorithm also initiates an alarm and records the detail in the database about the person not wearing the mask.

IV. RESULTS AND DISCUSSION

Once the RFID reader reads the RFID tag correctly, then two stage screening process begins. Two stages of screening include mask detection stage and temperature monitoring stage. In the first stage, the tensor flow based deep neural networks identifies whether the student is wearing mask or not. Here, the current data is compared with the trained data set and the result is obtained. The results of the mask detection systems are shown in the figure 8 and figure 9.

Fig.8: Classifier detecting the image as with-mask

Fig.9: Classifier Detecting the image as without mask

Figure 10 describes the intimation message sent to parent regarding the non-availability of the mask with their ward. The student is not admitted into the bus in order to prevent him from travelling in the bus with huge risk factor.

Fig.10: SMS indicating the non-availability of mask

Once the first stage of screening is crossed, then the temperature of the student is monitored using IR temperature sensor. When the temperature of the student crosses the threshold level, an SMS will be sent to the parent regarding the health condition of their child. This is explained using figure 11.

Fig.11: SMS indicating the health condition of the student

The GPS facility that is available in our system, tracks the location of the bus and sends the location details frequently to the parents until the bus reaches their boarding point. This is depicted in the figure 12. This helps the parent to prepare their child before the bus reaches their home.
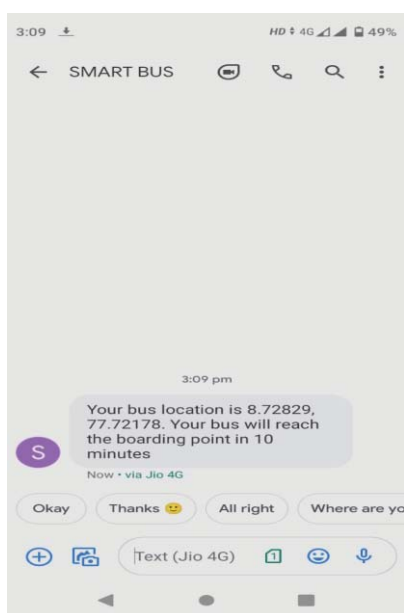
Fig.12: SMS with Bus Location details

Safety precaution details sent to the parent through our system is depicted in figure 13. This helps the parent to check the availability of sanitizer and mask with their child which is very much necessary during the travel to prevent their child from the spread of the disease.
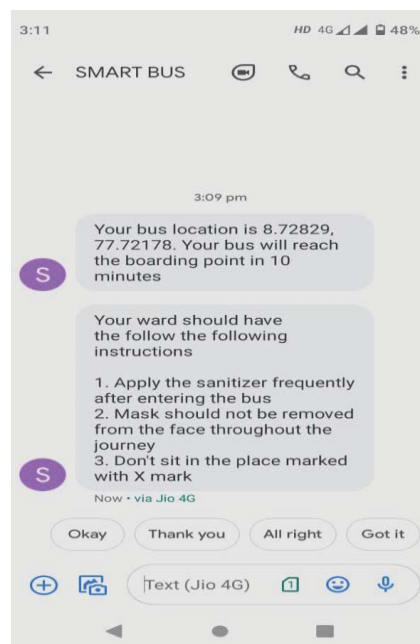
Fig.13: SMS denoting the precautionary instructions

Table 2: Database Maintenance

Bus_No	Stud_ID	Boardingpoint_Time	Pickup_Status	Alert_Info
B01	ID12	2021/01/10 07:00:34 AM	Yes	No
B01	ID03	2021/01/10 07:02:28 AM	Yes	No
B03	ID06	2021/01/10 07:02:34 AM	No	Yes
B04	ID19	2021/01/10 07:03:28 AM	Yes	No
B02	ID20	2021/01/10 07:02:34 AM	Yes	No

Table 2 depicts the database maintenance of our system. It maintains the details regarding student identification number, their entry time, and the alert information status for parents.

V. CONCLUSION

Our Secured College Bus Management System (SCBMS) provides a two-stage screening process which checks the availability of the mask during the first stage and monitoring the temperature of the student during the second stage. If any student fails to pass these two stages of screening, an alert message will be sent to their parents and management intimating the status of the student. SCBMS system also updates the bus attendance to the authorities. This system also sends the location of the bus periodically to the parents until the bus reaches their corresponding boarding point. Hence our system ensures safe travel and in addition to it monitors the attendance of the bus correctly.

We can introduce blockchain technology for secured database management. The temperature and the moisture level

inside the college bus can be monitored to enhance the comfort level of their travel.

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