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Smart Classroom Monitoring using Machine Learning and IoT

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Abstract - *Students are more willing to adopt creative teaching techniques and demand innovative university campus life in this era ofsmart classroom technologies. IoT and cloud computing technologies can offer solutions for a smart and sustainable campus to enhancestudents' learning processes and boost the effectiveness of routine tasks carried out within the institution. This project focuses on integrating the cloud into the educational processusing the IoT paradigm. IOT in education enables students to study cutting-edge technologies that aid in the development of fresh concepts and rational solutions to societal challenges. Using online portals, PDA users can view their homework assignments and test results. Online video lectures allow students to remotely join in on class lectures thanks to the ability to upload videos to the cloud. Information sent to and from sensor modules is processed by the software module before being sent to cloud storage.*

Key Words: microcontroller board, sensor, wireless and wired interfaces, software module, cloud storage.

1.INTRODUCTION

Universities have recentlybegun to focus on Internet of Things and cloudcomputing to create smart campuses. A SmartCampus connects many peripherals,infrastructure, and facilities to provide smart lighting, security, tracking, and effective use ofresources like manpower, electricity, water, etc. According to the traditional classroom model, managing the classroom's daily operations and teaching must take up equal amounts of time. Tohandle the workflow that drastically reduces the amount of time faculty have to devote to It extends the amount of time spent instructing and interacting with students. This project demonstrates a technique that uses cloud computing, IoT, and an application development platform to lessen secondary human labour. Additionally, it has automatic fan and light on/offfunctions that are based on the ambient conditions. With this approach, teachers wereable to concentrate more on what they do best— teaching—and less on running the classroom's daily operations.

2.LITERATURE SURVEY

2.1 Services Computing System Based on Smart Classroom

Published in: ICT for Smart Society 2019 International Conference (ICISS))

Abstract : In order to give its learning methods using AI-based technology, a smart classroom blends traditional and correspondence learning. Its goal is to support both synchronous and asynchronous learning. In order for teachers and students to apply a variety of teaching strategies, engage in active learning, and share knowledge, the smart classroom also makes use of the connectivity of smart devices.

2.2 Smart classroom: A universal classroom's entrance design

Published in: 2014 International Conference on Web and Open Access to Learning (ICWOAL)

Abstract: Today new techniques and researches in computers helped us to shift from conventional education to smart classroom. The pupils should be able to cooperate with one another using laptops, tablets, or other technology.

2.3 Automatic Light Switching and Temperature based fan speed control using microwave. temperature and LDR sensor.

Published in: 2021 International Research journal of Engineering and Technology(IRJET).

Abstract: Because it provides necessities, comforts, and conveniences, energy use has decreased; as a result, we dislike its use The approach for automatic lighting system

and temperature equipment switching will be covered in detail in the paper that follows. It entails monitoring sunlight intensity, detecting human presence, and regulating fan speed in accordance with ambient temperature. Our design may be broken down into three different categories: a human detection circuit using a microwave sensor, a light detection circuit using an LDR to detect sunlight, and a fan speed control system using a temperature sensor and associated switching circuits.

3.METHODOLOGY

The word "Smart Classroom" is used to describe a classroom that been outfitted with technology to support preaching. We frequently see that the instructor spends a lot of time from the time they enter the class until they leave it on secondary tasks like taking attendance, which can take a long time (especially in classes with more than 60 students), and then changing the lighting in the room, among other things. The teacher is thus only given a portion of the allotted time, which is frequently not enough. The greatest way to fix this problem would be with smart classrooms.

The secondary duty might be finished in a very little amount of the allocated time with the help of a smart classroom, making it easier for teachers to focus on their primary task of teaching. With the use of the facial recognition system, it allows the teacher to track attendance. as well as manage the lighting and projector. The study materials are even accessible to pupils via email. Our idea for a simple smart automation system can do everything from recording attendees' attendance using facial recognition to regulating the electrical devices in the space. It has occurred to us to create an Android-based application that would be essential for performing numerous tasks, like taking attendance and managing the lights in the room. The routers that must be put in each classroom and lecture hall would allow this programme to run on the local server. This application would be accessed by the academic staff. The installation of a camera in the classroom is necessary, among other things, for facial recognition to track attendance. There would be a system for students in addition to the teaching flank. Each student would receive the study materials via mail after a predetermined amountof time. In a folder they wish the pupils to have access to, the teachers upload the materials.

4.ARCHITECTURE DIAGRAM

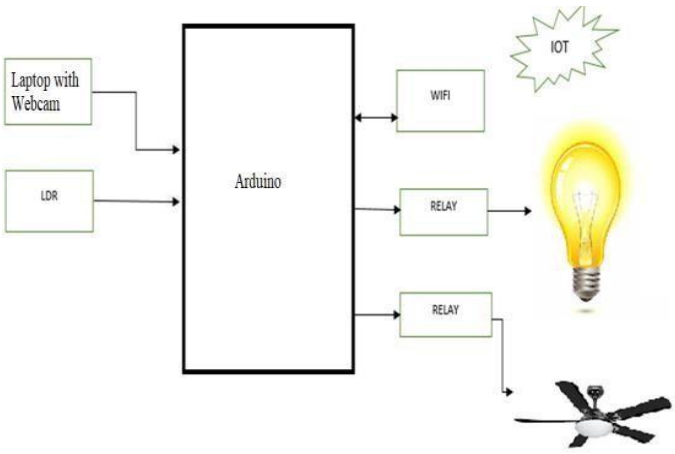

Fig-1 Hardware Architecture

Arduino : An open-source piece of hardware and software called Arduino makes single-board microcontrollers and microcontroller kits that may be used to build interactive objects and digital devices that can sense and control things in both the real world and the virtual one. Use of the open-source hardware and software created by the project is governed under the GNU Lesser General Public Licence (LGPL).Commercially, Arduino boards are available as assembled products or as kits designed for a specific application. The Arduino Uno board and pin diagram, respectively.

There are other variations of the Arduino Uno, including the Arduino Nano, Arduino Pro Mini, Arduino Mega, Arduino Due, and Arduino Leonardo.

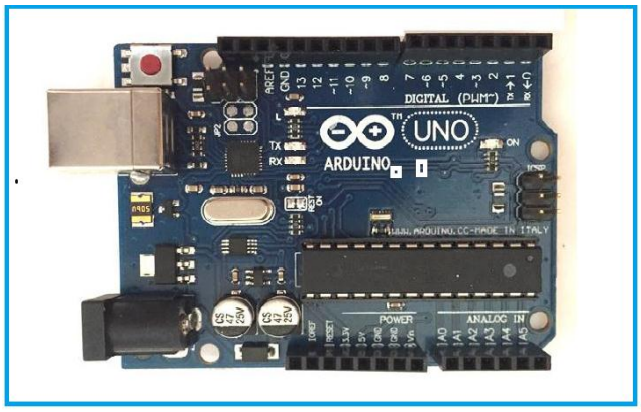

Fig -2 Arduino Uno Board

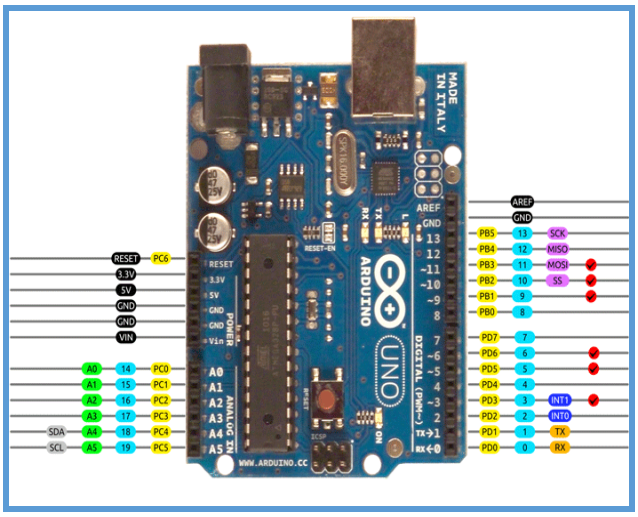

Fig-3 Arduino Uno board pin diagram

Wi-Fi: enables the operation of local area networks without wires and wiring.

Relay: A relay is a switch used to manage circuits. An electrically controlled switch is a relay. Mechanical switching is often operated by an electromagnet in relays. It is a 5-terminal gadget with 1 coil inside. A slit moves from one point to another when the coil is activated.

LDR: Light Dependent Resistors (LDR) are used to measure light intensity or to signal thepresence or absence of light. Particularly in light/dark sensor circuits, LDRs, or light dependent resistors, are particularly valuable. These aid in automatically turning on and off lights, such as streetlights, etc. Normally, an LDR's resistance is very high—up to 1,000,000,000 ohms—but when it is illuminated by light, that resistance drops sharply. Electronic opto sensors are objects that change their electrical properties when exposed to visible or infrared light. The light dependent resistor (LDR), photo diode, and phototransistors are the most popular products of this category.

Open CV: Open CV is a sizable open-source database. To recognize items, people, or even human handwriting, one can process photos and videos.

Open CV (View a picture)

To read an image, use the function cv2.imread(). The image must be in the working directory or have a complete path specified.

A flag serving as the second input designates how the image should be read.

A color image is loaded using cv2.IMREAD_COLOR. Any image transparency will be disregarded. This is the standard flag.

• cv2.IMREAD_GRAYSCALE loads the image in grayscale

• cv2.IMREAD_UNCHANGED: Loads the image as is, with the alpha channel included.

Open CV(Show a picture)

To display an image in a window, use the function cv2.imshow(). The window automatically adjusts to the size of the image.

The window name, which is a string, is the first argument. Our image is the second defense. You can make as many windows as you'd like, but each one will have a different look. A keyboard binding function is ncv2.waitKey(). The time in milliseconds is its main point. The function waits a predetermined amount of time for any keyboard event. The programme keeps running if you press any key during that time. If 0 is passed, it continuously waits for a keystroke. Additionally, as we will discuss below, it can be configured to recognize particular keystrokes, such as if key A is pressed.

Simply put, cv2.destroyAllWindows() eliminates every window we've created.

Temperature Sensor: A temperature sensor is a device designed specifically to tells how hot or cold an object is. The output of the accurate IC temperature sensor LM35 is proportional to the temperature reading (in °C). The LM35 can monitor temperature more precisely than a thermistor. It also has capable of minimal self-heating and only slightly slights the temperature of still air, by no more than 0.1 °C. The range of operating temperature is between -55°C and 150°C.The LM35 is exceptionally easy to interface with reading or control circuitry due to its low output impedance, linear output, and perfect internal calibration.

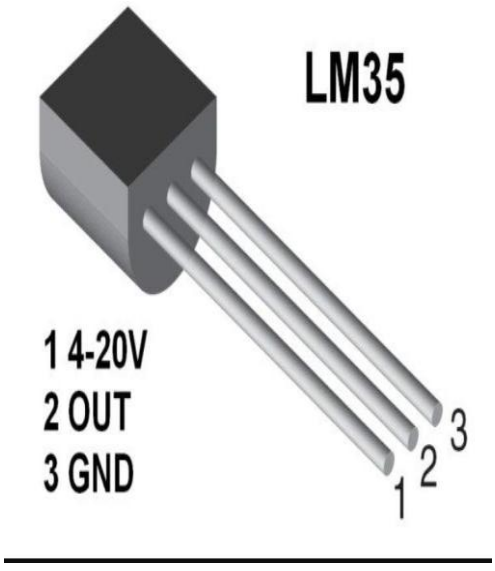

Fig-4 Temperature Sensor

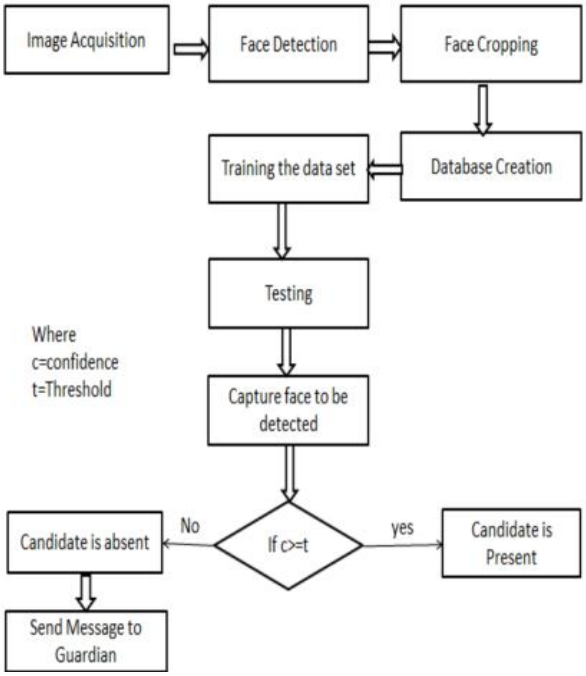

Fig-5 Software Architecture

Automation Will happen based on input from camera. Using camera we will detect studentsinside the class.

5.ALGORITHM

5.1Haar Classifier:

This framework for object detection aims to deliver competitive object detection rates in real-time, such as face detection in an image. A person can accomplish this effortlessly, but a computer need specific guidelines and limitations. Full view frontal upright faces arenecessary for Viola-Jones in order to make the task more feasible. Therefore, the full face must face the camera and cannot be slanted in any direction in order to be recognized. Since the detection stage is typically followed by a recognition step, these limitations on pose look like they would slightly reduce the algorithm's utility, but in actuality they are fairly acceptable the qualities

The Viola-Jones technique is a powerful detection algorithm because it has the qualities listed below:

a) Robust – Very high true-positive detection rate and very low false-positive detection rate at all times.

b) Real time – At least two frames per second must be processed for practical applications.

c) Only face detection, not face recognition – Since detection comes before recognition, the objective is to tell faces from other objects.

Features

- An approach of detecting object with Machine Learning is called Haar cascade.
- A situation where a cascade function is trained using a sizable number of both positive and negative images.
- Then, using the training data, it is used to identify objects in the other images.
- They are large individual.xml files with numerous feature sets, and each one of them relates to a very unique kind of use case. This is how it works.

5.2 Histogram of oriented gradients (HOG)

It is a feature descriptor used to identify objects in computer vision and image processing. Using a detection window or region of interest (ROI), the HOG descriptor technique counts instances of gradient orientation in targeted regions of a picture.

The HOG descriptor algorithm is implemented as follows:

1. Calculate for each cell in the image by dividingit into small, connected areas called cells.

2. A cell's pixel histogram showing the gradient axes or edge orientations.

3. Weighted gradient is contributed by each cell's pixel to the associated angular bin.

4. Blocks are thought of as spatial entities that consist of a collection of contiguous cells. Histograms are normalized and grouped on the basis of the arrangement of cells into blocks.

6.IMPLEMENTATION

The implementation of the Hardware and Software. Using machine learning and IoT, there are various processes involved in creating the software components for a smart classroom monitoring system.

6.1 Hardware Implementation:

The hardware includes an LDR sensor for sensing light, which means that when the humidity is higher or when it is darker outside, the device will turn on and off as needed. Other devices, like as a temperature sensor, are used to turn on and off fans. A few more include an Arduino Uno microcontroller board, a relay, a power source, an LCD, an LED, and a fan. The following actions are taken in order to implement the hardware architecture:

Compile the necessary hardware parts.

1. Attach the power supply, Arduino Uno microcontroller board, and temperaturesensor and LDR. Connect the proper pins on the power supply and microcontroller board with jumpers.

2. In order to display the values that indicate the changing temperature and humidity, connect an LCD display to the microcontroller and power supply.

3. To control a circuit with a separate low-power signal, connect the relay to the power source, the LED, and the fan.

4. The Fan now turns on automatically as the temperature rises and vice versa.

5. The light itself automatically turns on when the humidity is high and vice versa.

6.2.Software Implementation:

The software component entailscreating an application that gathers student information, displays the number of present and absent students as well as any lingering questions about the subject matter of the class. The software implementation involves following steps.

1. Install the necessary software tools, such as the OpenCV, Arduino, and Anaconda libraries.

2. The system is broken down into three modules: database building, dataset training, testing, and alarm message sending as an addition.

6.2.1.Building Database

a) Restore the camera's default settings and turn on the alert message to get the students' attention.

b) Obtain the user ID.

c) make the image grayscale and find the face.

d) Store the given input in the database using it as a label for up to 20 frames.

6.2.2.Training

a) Set up LBPH face recognizer.

b) Use the database file to retrieve faces andIDs for the LBPH face detect.

c) Hold the learned data as an xml or yml file.

6.2.3.Testing

The Haar classifier and LBPH face recognizer should be loaded along with trained data from an xml or yml file.

a) Snap the photo using the camera,

b) Change it into gray scale,

c) Recognize the face in it and

d) Using the aforementioned recognizer, predictthe face.

6.2.4.For raising the doubts :

a) Create a server using telegram app.

b) By using Bot father create a channel.
c) Send the doubts related to the topic covered using the smart phone through the channel in the telegram app.
d) The raised questions will get displayed on the screen or on the projector screen.

6.2.5. Indoor Navigation:

a) Create a server using telegram app.

b) By using Bot father create a channel.

c) Insert a picture related to the place through a Microsoft word though mapping.

d) As the text arises as to rise the doubt immediate an option will be provided to selectthe required location or the place.

e) After giving the option or after selecting the option the route will be obtained automatically.

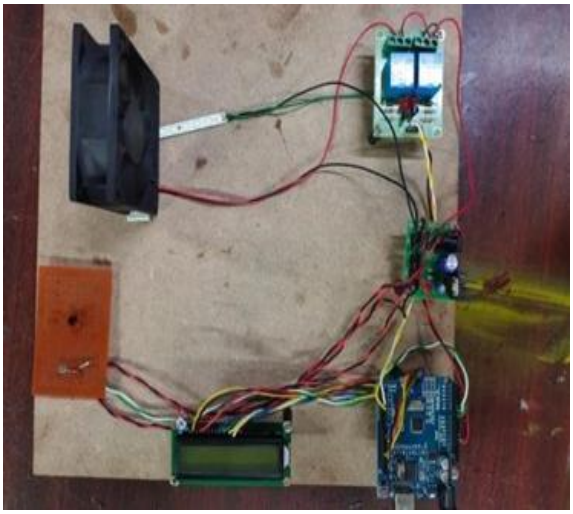

Fig-6 Hardware Components

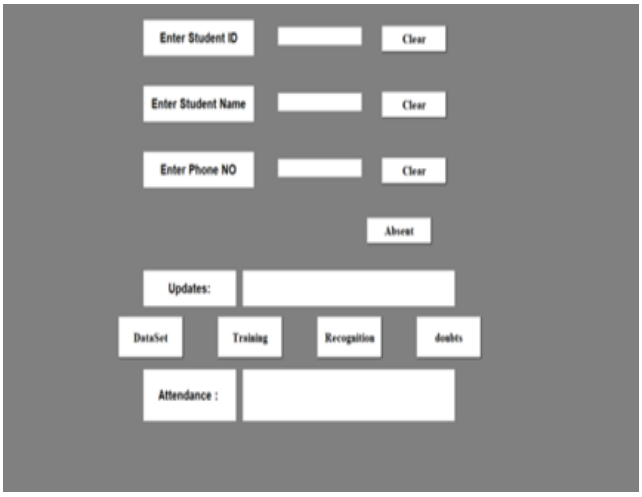

Fig-7 Database Creation

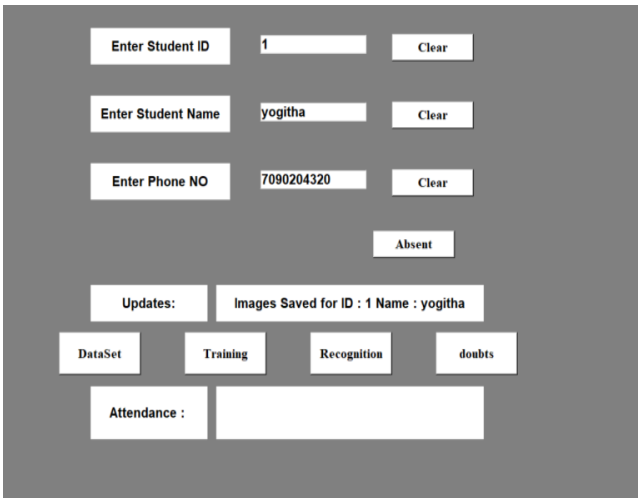

Fig-8 Database entry

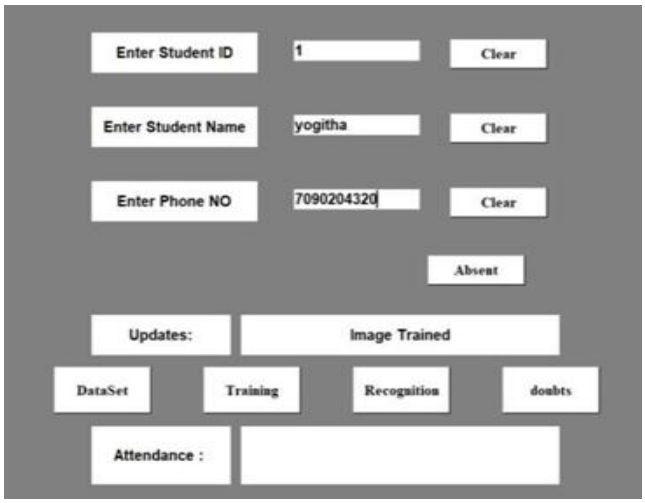

Fig-9 Image trained

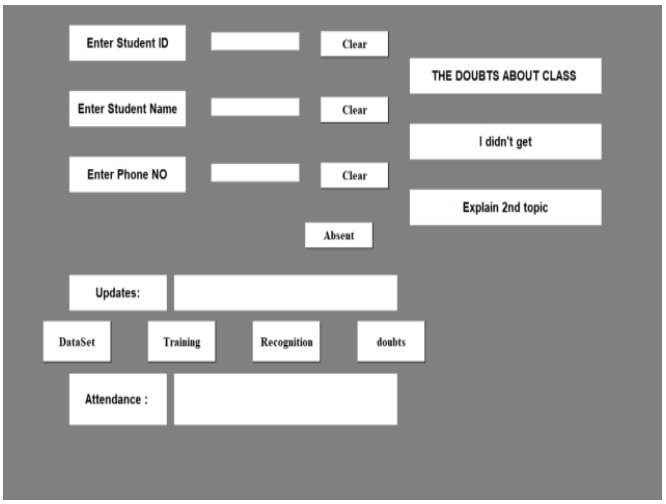

Fig-10 Doubts Raising.

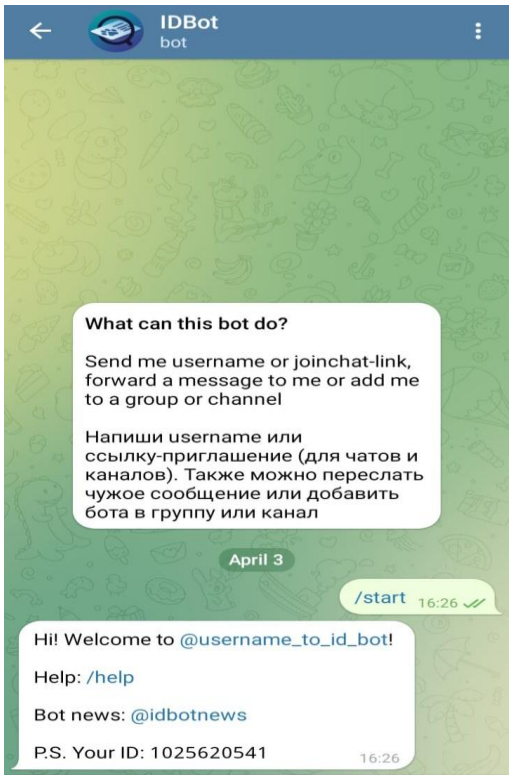

Fig-11 Creation of the channel.

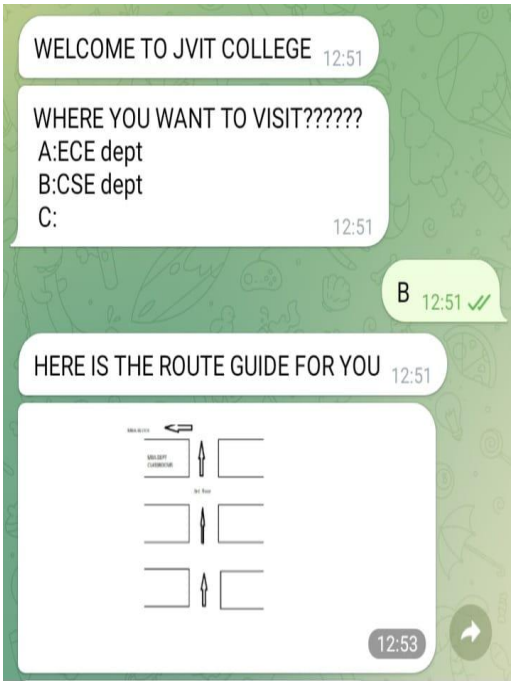

Fig-12 Showing the route map of selected option.

7. CONCLUSION

The IoT-based Cloud Integrated Smart Classroom for Smart and a Sustainable Campus is a development in the educational environment that will lead to high efficiency and effectiveness of the classroom teaching approach. This technique will increase the community of students' sincerity in completing their assignments on time. Instead, faculty and administration may devote more time to teaching and learning. of controlling and observing the classroom's workflow. In order to deliver an intelligent, economical, and environmentally sustainable campus, the proposed education system model. The automated attendance system's objective is to reduce mistakes made by the current (manual) attendance taking system. The goal is to automate and develop a system that is advantageous to the institution or other organization. The up-to-date, accurate replacement for manual techniques that can be used to collect attendance in workplaces. This approach is workable, dependable, and sufficiently safe. Without the need for specialised hardware, the system can be implemented in the office. It can be made with a camera and computer. It may be said that a manual and unreliable method for managing class attendance has been replaced by one that is dependable, secure, quick, and efficient. Time will be saved, less work will need to be done by the administration, and already existing electronic equipment will take the place of the stationery currently in use. The system only requires a computer and a camera for installation, therefore no specialised hardware is required. Since the camera is necessary for the system to function, it is crucial to test the image quality and camera performance in real-world situations ,when the system is connected to the camera. This type of system can also be used in highly reputed schools and colleges and also in the home.

The main disadvantage of this is spoofing. In the upcoming days one method has been brought into force to overcome the disadvantage like eye blink detection may be utilized to know the difference between present and still images if face detection is made from snapshots of the classroom. Human intervention might be used to make the system error-free based on the system's overall efficiency, which is 83.1%. Therefore, a module make a list of all the unrecognized pictures and enables the teacher to himself check the attendance. In the future, several organized attendance registers for each class as well as the ability to generate itself monthly absents and presents reports and automatically email them to the necessary employees for evaluation may be introduced.

Indoor navigation and raising doubts in the conference hall is also the updated method inside the campus. Where an unknown person can easily find the route to the location he has to visit within the short period of time.

Raising doubts lets every student to represent their doubts without hesitating and also makes the interaction very easy between the teacher and the student.

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