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Visitors Robotic Guide Using Raspberry PI

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ABSTRACT: The creation of a robot for clearing trash from the water's surface is described in this chapter. *:* In recent years, the integration of robotics and artificial intelligence (AI) has paved the way for innovative solutions in various domains. One such application is the development of a Visitor Guide Robot (VGR), which serves as an interactive and intelligent guide for visitors in museums, exhibitions, or large facilities. This project aims to design and implement a VGR using Raspberry Pi, a versatile and cost-effective single-board computer. The proposed VGR incorporates several key components, including Raspberry Pi for processing and control, sensors for environment perception, motors for mobility, and a user interface for interaction. The robot utilizes computer vision techniques for object recognition and navigation, allowing it to autonomously navigate through the environment while avoiding obstacles. Additionally, natural language processing (NLP) algorithms enable the VGR to understand and respond to visitor inquiries effectively. The development process involves hardware integration, software programming, and testing to ensure the functionality and reliability of the VGR. The Raspberry Pi serves as the central hub for processing sensor data, executing control algorithms, and facilitating communication with the user interface. Various sensors, such as cameras, ultrasonic sensors, and infrared sensors, provide the necessary input for environment perception and obstacle avoidance.

Keywords - Robotics , artificial intelligence, Visitor Guide Robot, Raspberry Pi, object recognition, navigation, , natural language processing

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I. INTRODUCTION

It is very difficult to find required places in an unknown location, if it is a large place then it will be very difficult. Our K.S Institute of Technology has a huge campus, it will be very difficult to find the branches, Blocks, Colleges, Hostels etc. Which are placed at different locations. So, our project ―Visitors robotic guide‖ which is very useful and solves the problems which is mentioned above.

Our model will provide voice assistance as well as image assistance to the new visitor who visits our campus for the first time. We all know that some people at this time will hesitate to talk with stranger or with any others, because of this Covid situation. We planned to solve this problem and make a ―**BOT**‖ which will assist visitors to reach their desired destination. Our―**Visitors Robotic Guide**‖ will give voice assistance of their required branch and show the route map on the display. Also, if they require the route map for their particular destination, we will display the QR Code, by scanning with their smart phone. In our college students from different states from all over India are studying, so we implemented total 5 languages (Kannada, Hindi, Tamil, Telugu and English).

For our model we require a controller for interfacing with our surroundings and for collecting the data from the user for processing and providing some expected result. So, in our project we are using raspberry pi as controller which is a credit-card sized computer. Now coming to the actual project is ―**Visitors Robotic Guide Using Raspberry PI**‖ which helps the new visitors to our campus in reaching the destination. The main intention of doing this project is because every year the number of visitors to our college increases that might be the new students admitting to the college as a fresher's or the students or the parents who come for the campus visit, they are new to the campus, our model will help them to reach their destination.

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II. LITERATURE SURVEY

"K. Manohar, L. Sai Kishore, G. MEERAGANDHI", in this paper the "Raspberry Pi Based Voice-Operated Personal Assistant" is a voice-controlled processor with a camera that interacts with picture to text conversion utilizing Open CV and OCR algorithms for visually impaired people. Infrared sensors aid in the recognition of the voice direction of those conversing with the visually impaired. The Open CV and OCR algorithms recognize the letters contained in the taken photographs from the camera and convert them to audio, which is then communicated to the consumer equivalent using the built- in voice. By incorporating the Raspberry Pi as a computing device, the disabled will be able to connect with their surroundings while also reducing stress by exposing them enlightening outlets. This emphasizes the importance of reducing screen-based interaction.[1]

"Asst. Prof. Emad S. Othman, Senior in their paper", "Voice Controlled Personal Assistant Using Raspberry Pi‖ uses this approach, which works on the principal input of a user's voice, is implemented using the Raspberry Pi as the main hardware. Using a speech to text engine to convert voice to text as an input. The text that resulted was then utilized to process queries and get relevant data. After the information was retrieved, it was transformed to speech using text to speech conversion, and the user was provided the appropriate output. In addition, various other modules based on the concept of keyword matching were implemented.[2]

"Dhiraj S. Kalyankar, Prof. Dr. P. L. Ramteke" The work seeks to create a personal assistant that lets consumers engage with home appliances via speech and gesture commands, resulting in a more interactive and user-friendly living experience, as well as the integration of many tools and aspects produced over the model's execution. The design and development of an IOT system is addressed in this paper, which includes providing voice commands and receiving output in the form of audio and visuals.[3]

"P Srinivas,T Sai Teja, CH Bhavana,R Likith ",‖Raspberry Pi Based Personal Voice Assistant Using Python‖, in these paper deals with a voice assistant that can perform a variety of tasks for the user, such as setting an alarm, setting daily reminders, knowing the weather forecast, reading the latest news feed, playing a song from a playlist, asking about the details of a movie, finding the meaning of an unknown word, reading a Wikipedia article, and controlling electronic devices.[4]

A Python based Virtual Assistant using Raspberry Pi for Home Automation **Kishore Kumar R, Ms. J. Jayalakshmi, Karthik Prasanna S.** The paper presents a Python-based virtual assistant that utilizes a Raspberry Pi for home automation. The virtual assistant can perform a variety of tasks, including controlling the lighting and temperature of the home, playing music, and setting reminders. The authors describe the hardware and software components of the system, including the Raspberry Pi, microphone, speaker, and various sensors. They also discuss the implementation of the virtual assistant using the Python programming language and various open- source libraries. The paper concludes that the virtual assistant system is an efficient and cost-effective solution for home automation. The system can be easily customized to meet the specific needs of the user and can be extended to include additional functionality as required. The authors suggest future improvements to the system, such as integrating machine learning algorithms for more advanced voice recognition andnatural language processing capabilities.[5]

"Voice Controlled Personal Assistant Using Raspberry Pi" by Ass. Prof. **Emad S. Othman,** Senior Member IEEE - Region 8, was published in the International Journal of Scientific & Engineering Research, Volume 8, Issue 11 in November 2017.The paper presents a voice- controlled personal assistant system using a Raspberry Pi. The system can perform various tasks, such as playing music, answering questions, and controlling smart home devices, through voice commands. The paper provides a detailed description of the hardware and software components of the system, including the Raspberry Pi, microphone, and speaker. The author also describes

the implementation of the personal assistant using Python programming language and various open-source libraries, such as the Google Text-to-Speech API and the Google Assistant SDK. The paper evaluates the performance of the personal assistant system in terms ofaccuracy and response time and compares it to other voice-controlled personal assistant systems. The author also discusses the limitations of the system and suggests potential areas for future research and development. The paper concludes that the voice-controlled personal assistant system using Raspberry Pi is an efficient and cost-effective solution for home automation and other tasks that can be performed through voice commands. The system is easy to use and can be customized to meet the specific needs of the user.

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Online Assistant Survey: Siri, Cortana, Alexa" © Nature Springer Singapore Pte Ltd‖. **S. Amritas**. **Tulshan and Sudhir Namdeoraodh** age Monsieur Thampi et al (2021). The study found that all three digital assistants had similar levels of accuracy, with a success rate of over 80%. However, Siri and Cortana were found to be faster in providing responses compared to Alexa. In terms of ease of use, Siri was found to be the most user-friendly, followed by Cortana and Alexa. The study also found that participants were more likely to use Siri for personal tasks, while Cortana and Alexa were preferred for work-related tasks. The study also analyzed the use of these digital assistants among different age groups and found that younger participants were more likely to use Siri and Alexa, while older participants preferred Cortana. Additionally, the study found that users who had more experience with digital assistants were more likely to prefer Siri over Cortana and Alexa. Overall, the study provides valuable insights into the performance of digital assistants and their popularity among users. The

findings suggest that Siri is the most user-friendly and preferred digital assistant for personal tasks, while Cortana and Alexa are morepopular for work-related tasks. The study also highlights the importance of considering user preferences and demographics when designing and developing digital assistants.[8]

"Autonomous tour guide robot using embedded system control‖. **Diallo, Alpha Daye, Suresh Gobee, and Vickneswari Durairajah.** Autonomous navigation is achieved through wall following using ultrasonic sensors and image processing using a simple webcam. The bitwise image processing comparison method introduced is writing in OpenCV and runs on the Raspberry pi. It grabs images and looks for the tags to identify each lab. A recognition accuracy of 98% wasattained

The user interaction was achieved through voice recognition on an android tablet placed on top of the robot. Google speech recognition APIs wereused for communication between the robot and the visitors.[9]

"Sensing and classifying indoor environments: An Iota based portable tour guide system‖.Aman,**M. S., Quint, C. D., Abdelgawad, A., & Yelamarthi, K.** The proposed system can provide personalized audio-visual information based on the location of the visitor, making the visitors independent of following a guide. The core of the module is a Raspberry Pi 3 with Bluetooth Low Energy (BLE) and Wi-Fi transceivers. Localization is performed using iBeacons, and RFID technology is used to identify certain objects. The Thingworx platform has been used as the application cloud server while YouTube has been used to present visual feedback to the user. The system uses machine learning algorithms to classify the indoor environment based on the sensor data. The sensors used include a temperature sensor, humidity sensor, light sensor, and air quality sensor. The data collected by these sensors is processed by a machine learning algorithm to classify the environment into different categories such as library, museum, or art gallery. The device also features a text-to-speech module that provides users with audio descriptions of the environment they are in. The device is designed to be easy to use, with a simple interface that allows users to start and stop the system easily. authors conducted experiments to evaluate the performance of the system, and the results show that the system is capable of accurately classifying indoor environments with a high level of accuracy. The system also provides users with a rich audio experience, which enhances their overall tour experience. The paper presents a fuzzy logic-based autonomous nursing robot system guided through a wireless beacon network. The system aims to provide assistance to patients who require regular medical attention by providing a reliable and efficient method of monitoring and providing medical aid. The nursing robot uses an array of sensors to gather data about the patient's physical condition and send it to the fuzzy logic-based controller. Based on the controller's analysis, the robot provides appropriate medical aid to the patient. The wireless beacon network allows the robot to navigate and locate the patient's position accurately. The proposed system is evaluated in terms of response time, efficiency, and accuracy, and the results show that it can significantly improve the quality of carefor patients.[10]

"Design and implementation of an autonomous indoor surveillance robot based on raspberry pi‖. **Dharmasena, T & Abeygunawardhana P,** this paper describes an autonomous surveillance robot that is being developed

while keeping the development costs as low as possible and is capable of performing routine patrols autonomously in indoor environments and detect anomalies around itsuch as temperature fluctuations, unauthorized personals and report them back to a central easily

The paper presents the design and implementation of an autonomous indoor surveillance robot based on the Raspberry Pi platform. The robot is equipped with a Raspberry Picamera module, ultrasonic sensors, and a motor control module for obstacle avoidance and navigation. The proposed system uses a Raspberry Pi to process video data and detect intruders based on motion detection algorithms. The robot can also be controlled remotely through a web- based interface, allowing users to monitor the robot's activities from a remote location. The results of the experiments conducted on the robot show that the system is capable of detecting and tracking intruders in indoor environments. The proposed system provides a cost-effective solutionfor indoor surveillance and can be easily adapted for a wide range of applications, including homesecurity and industrial automation.[11]

"Autonomous Museum Tour Guide Robot with Object Detection Using TensorFlow Learning Machine‖. **Umam Faikul, Firmansyah Adiputra, Ach Dafid, and Sri Wahyuni**. The tool's implementation is controlled by the deep learning Convolutional Neural Network method using the Tensor flow framework to recognize and classify the detected objects. The robot that will be created is a 3-wheeled robot with one camera as a sensor to detect objects around the robot. The robot is equipped with an audio speaker to provide object detection information. The robot detected six objects at the Sumenep Palace Museum, which were integrated into a robot with a 100% success percentage in the 5th epoch with the 175th iteration. The time required was 117.11 error of 0.393. Weaknesses in this study are the need for control throughout the tour guide robot so that it runs more stable and the use of a camera with a higher resolution, but when run on the system, it does not affect system performance. The paper presents an autonomous tour guide robot for a museum that uses TensorFlow-based object detection techniques to identify artifacts and navigate the museum. The robot is designed to work in indoor environments and can detect and avoid obstacles. The authors used a Raspberry Pi for the control system and a camera for object detection. The robot can recognize and classify several artifacts in real-time and provides audio and visual information about them to the users. The system is tested in a real museum environment, and the results showed that the robot can navigate and provide useful information to the users. The study concludes that the proposed system can enhance the museum visitor's experience by providing an interactive and informative tour.[12]

Design and Implementation of an Interactive Docent Robot for Exhibitions‖. **Chen, Y., Li, J., Ni, R., & Liu, X.** The service robot completes the functions of multi-point navigation, autonomous obstacle avoidance and explanation in the local embedded device through path planning algorithm.

To achieve the anthropomorphic interaction effect, an anthropomorphic robotic head for interaction is designed to realize the facial action change in the process of explanation and interaction. In addition, the functions of human-robot dialogue and facial recognition based on convolutional neural network are realized on the cloud platform. The experimental results in navigation accuracy evaluation and human-robot interaction show that the service robot designed in this paper can maintain stable motion, accurate navigation, and natural interaction. The paper presents the design and implementation of an interactive docent robot for exhibitions. The robot can conduct tours, answer questions, and provide information about exhibits to visitors. It is equipped with a variety of sensors, including a depth camera, microphonearray, and touch screen, allowing it to interact with visitors in a natural way.[13]

EEG based Smart Wheelchair using Raspberry Pi for Elderly and Paralyzed Patients‖. **Shashidhar, R., & Tippannavar, S. S.** This research presented a wheelchair development control framework for the disabled that is dependent on EEG signals of the human cerebrum using face movements, eye blinks, electrical signals, human ideas, and muscle contractions. A comparison of microcontrollers available on the market revealed that the Raspberry Pi is the bestsuited single board computer, with the feature that allows us to configure and connect the wireless BCI EEG headset via Bluetooth, as well as access the board remotely and update any required features. The number of times the patient visits the center for updates is decreased by using the remote connection feature. It supports parallel processing and enables us to process brain signals more quickly and with fewer errors. Using sensors affixed to a person's scalp, the Brain-Sense device detects BCI waves and analyses them afterward. Additional applications that combine automation, IoT, and security features can be used with the BCI headset. The paper presents the design and development of an EEG-based smart wheelchair system for elderly and paralyzed patients using Raspberry Pi. The proposed system can assist such patients in controlling their wheelchairs using EEG signals obtained from the brain. The system uses an EEG headset to acquire the EEG signals and Raspberry Pi to process and control the wheelchair movements. The system consists of three modules, namely the EEG acquisition module, the signal processing module, and the motor control module. The proposed system is tested and evaluated using a prototype wheelchair with four wheels. The results show that the system can accurately detect theuser's intended movements and control the wheelchair movements accordingly. The system can be helpful in providing a safe and independent mobility solution for elderly and paralyzed patients.[14]

Fuzzy guided autonomous nursing robot through wireless beacon network‖. **Narayanan, K.L., Krishnan, R.S., Son, L.H., Tung, N.T., Julie, E.G., Robinson, Y.H., Kumar, R. and Gerogiannis, V.C.** The system performance was evaluated on a PC with an Intel Core i5 processor, while solar power was used to power the system. Several sensors, namely HC-SR04ultrasonic sensor, Logitech HD 720p image sensor, a temperature sensor and a heart rate sensor are used together with a camera to generate datasets for testing the proposed

system. In particular, the system was tested on operations taking place in the context of a private hospital in Tirunelveli,Tamilnadu, India.

A detailed comparison is performed, through some performance metrics, such as Correlation, Root Mean Square Error (RMSE), and Mean Absolute Percentage Error (MAPE),against the related works of Deepu et al., Huh and Seo, Chinmayi et al., Alli et al., Xu, Ran et al., and Lee et al. The experimental system validation showed that the fuzzy controller achieves very high accuracy in obstacle detection and avoidance, with a very low computational time for takingdirectional decisions. Moreover, the experimental results demonstrated that the robotic system achieves superior accuracy in detecting/avoiding obstacles compared to other systems of similar purposes presented in the related works.[15]

III. BLOCK DIAGRAM

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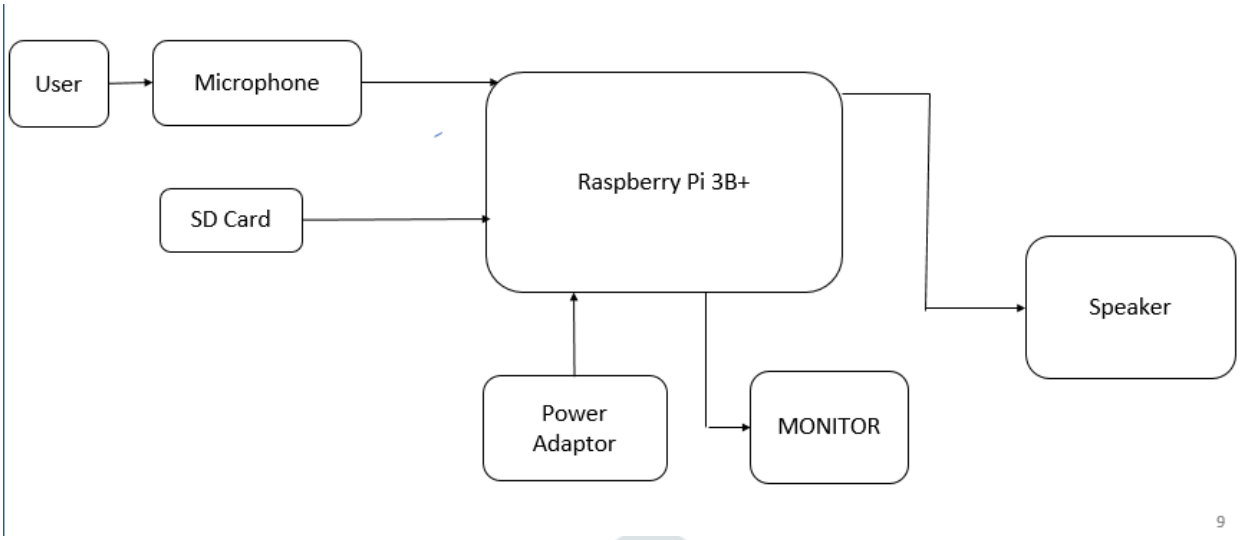
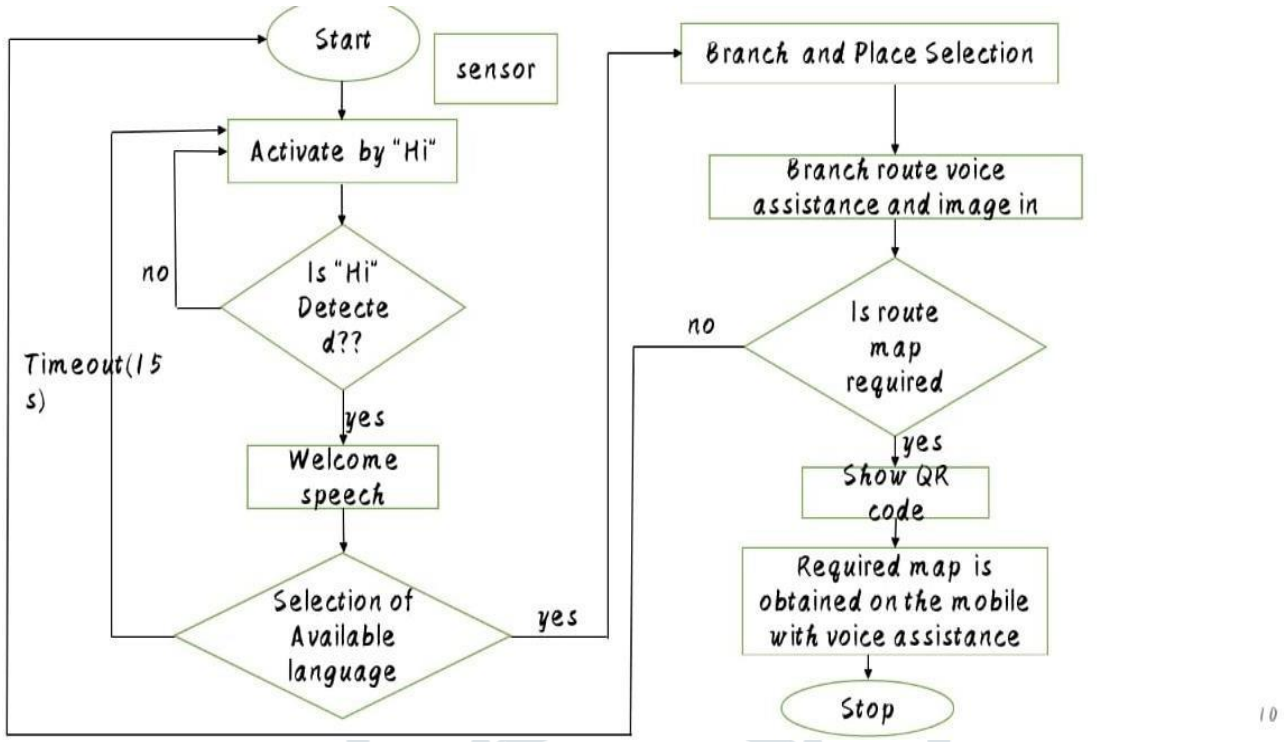


Fig 1: Block Diagram of visitor guide robot

IV. FLOW CHART



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V. METHODOLOGY

Using the block diagram shown in the fig 1.

1. Initially, the model will be placed at the entrance gate of our college near the security room. So that new visitors, students, or anyone who is new to our campus can evidently see the model. As a result, visitors can easily locate and communicate with a pedestrian robotic guide for accurate route guidance.

2. To activate and operate the model, the user needs to speak in front of the model using the —HELLO" activation key. The moment the user says HELLO, the model will start working.

3. Continuing to the second step, after saying Namaste, the model itself requests the user to select the language, among Kannada, English, Hindi, Tamil, and Telugu.

4. Eventually, the user needs to select any one language among those. Based on that selected language, the pedestrian robotic guide proceeds to communicate in the selected language.

5. Then it will again ask the user to select the branch where they need to go. Similar to the third step it shows the list of branches.

6. The visitor must choose one of the branches that are displayed on the screen.

7. Based on the branch selected by the visitor, the Raspberry Pi's control thread will perform a task that

finds the related address and presents the result on the smart screen and via speaker.

8. Once the Visitors robotic guide completes telling the route path to their particular destination branch, the model will ask the user if they want the route map, if a visitor wants that route map, he/she can get it by scanning the QR code with their smart phone

VI. RESULTS

The bought components like Raspberry pi, Speaker, Microphone, Power Adaptor, HD, Monitor, all the components are connected to the Raspberry pi though USB port.

The Microphone takes the user voice input and feeds to the Raspberry pi, at the Beginning user should have to say the active key to activate your model, once the user said the activate key raspberry pi detects that activate key and turn on the program. If the user will not respond through the activate key, the program will not be activated.

Monitor is used display the uses full information and display the particular route map to respective destination along with these it will display the QR code to provide to route map to the user.

Ones the Raspberry pi detects the activate key will response to the users asking to choose the particular language to guide them through via voice and display the available option on the monitor. After Selecting the language, it will display the all the destination names and I will ask them to select the require destination.

If the user gives to proper destination name, it will guide them through saying route direction along with this it will show the image of the rote map which they are asked this each process happens simultaneous so the users can understand the route accurately else I will replay back say again.

After guiding them to the required route it would ask the user to do want the rote map if user said yes, it would display the QR code if the user scanned that QR code user will get their wanted rote map.

Used the python language to program, modules like speech Recognizer to take the voice input from the user, GPIO module to display the image, play sound module to guide the user through voice output and so on.

Figure2: Idle state

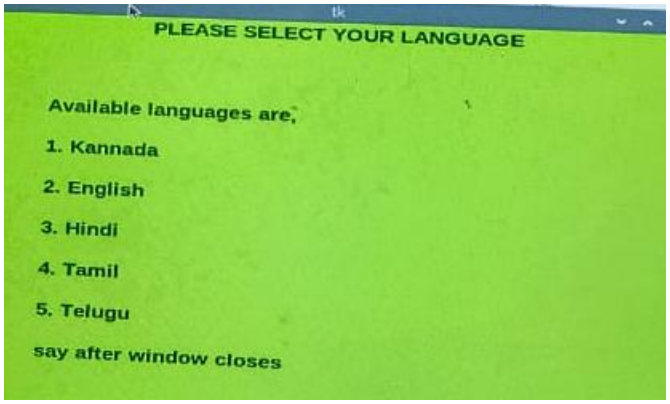

Figure 3: Select your language

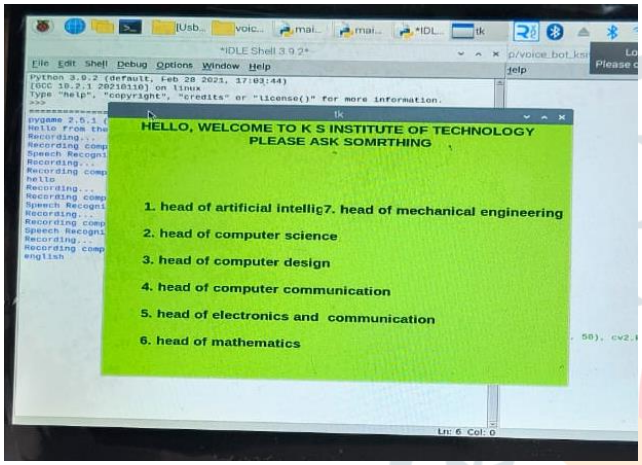

Figure 4: Information about facaulty

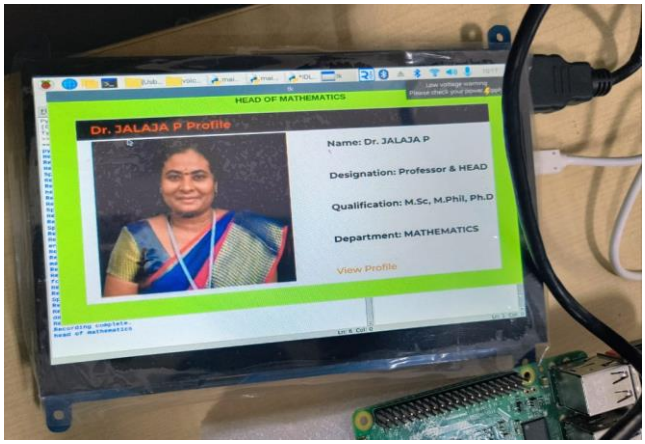

Figure 5:Information about professor

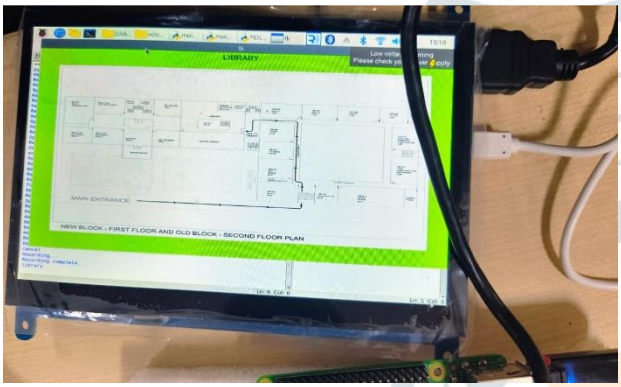

Figure 6: Display the map

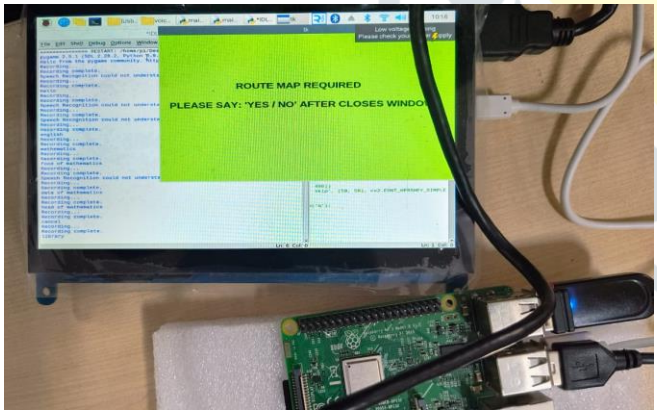

Figure 7:QR code reqired

Figure 8:Display QR code

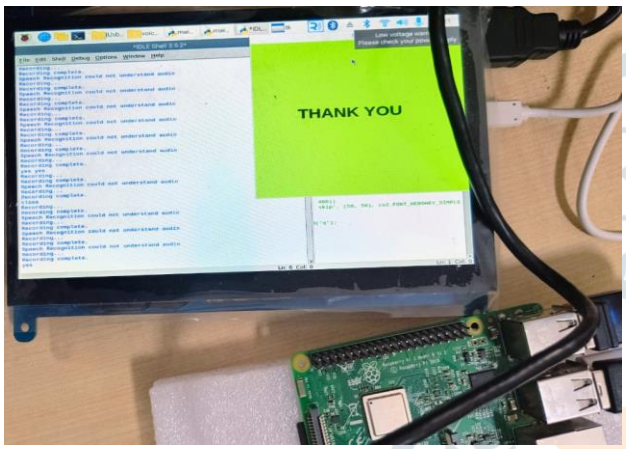

Figure 9

VII. CONCLUSION AND FUTURE SCOPE

The project's main goal was to create voice assistants that could provide the user with all of the information they need to get to their destination. Voice assistants have altered the way people engage with technology. Currently, everything is controlled by voice or via the internet, such as Google's voice search service, Alexa, and other services. Here, we will not only provide voice assistance, but we will also display a route map for a specific destination.

Using technology, we can improve the model by displaying college information such as number of admissions, placements, and even maintaining visitor data by asking for the visitor's name and mobile number and saving it into the database. These types of projects are very useful in large campuses such as universities, industries, and hospitals because they provide accurate information about the destination and save time. We can even implement the fastest route on the campus using AI and ML techniques. The idea is to give folks a quick and easy way to get answers to their inquiries so they can go to their destination.

The future scope for a visitor guide robot using Raspberry Pi is promising, with potential advancements in various areas.

Enhanced Navigation Integration of advanced navigation systems like SLAM for autonomous navigation in complex environments.

Natural Language Processing (NLP): Improved understanding and response to natural language commands and questions.

Personalization: Tailoring interactions based on individual visitor preferences and past interactions.

Augmented Reality (AR) Integration: Overlaying digital information onto the visitor's environment for enhanced experiences.

Emotional Intelligence: Recognition and response to human emotions for more engaging interactions.

Multi-Robot Collaboration: Coordination and communication among multiple robots for efficient assistance.

Integration with IoT Devices: Utilizing real-time data from IoT devices to optimize navigation and recommendations.

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