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A Robotic Smart Receptionist Management System

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ABSTRACT: Today's world clearly depicts primary issues by investigating on the human to robot interaction interference, as a part of receptionist projects defined to do the work as a receptionist at an office or an institution. Due to increase in educational aspect, improvement in artificial processing system has been evolved. Introducing a robot for the institutional reception desk for the computerized guidance is necessary.

The designed character named robot receptionist, is built with a motional movement, and can display a human face-like appearance with the camera inserted to it, which can detect and recognize the guests visiting the office or an employee working in it. Robot remains stable until a signal is provided, once gets the signal of visitor in an institution, it welcome's and interact with them and can ask the guest the purpose of the visit and convey the message to the concern person and waits for the response from the concern person. Providing Haar-Cascade algorithm along with Open CV for face detection and recognition and, the text to speech functions to define the natural speech processing is defined. Based on the instruction provided, authority in-charge can respond to the messages. Finally, inculcates the process how a robot can be suitable for the job of receptionist.

KEYWORDS: Human robot interference, Robot Receptionist, Movement, Detect visitor, Another visit, Face detection, Face recognition, Speech process, Open CV, Haar-Cascade Algorithm, Artificial Intelligence.

I. INTRODUCTION

An interdisciplinary branch of robots that deals with the construction, development, integration and implementation of machines with information processing or the sensory controllable machines that are increasingly very relevant in the social interventions are defined with robotics, an artificial intelligent technology. The social service robots are importantly plays a special role in the real-life.

The field of research and development, [1] multiple kinds of interaction-oriented robots [9][10] are frequently notified. These type of machine build called robots are expected to interact with the humans in their daily lives or in their office spaces. Non-verbal medium is a level of communication with an important aspect in realization for smooth form of the communication and most part of robots try to share the information with the human not only through the verbal form of communication but it also includes the non-verbal form of communication like speech, modality, move, voice and so on. Because of their physical appear they are mechanically represented as robots. Few robots with human like appearance are defined as the android robots. [2][4][5][7] It represents the human-machine-interaction (HMI) level. The main asset of robots is to give a strong essence for the presence while communicating with real humans. They also bring a human-to-robots communication very familiar to the human to human interaction /communications.

As aware that robots are of increased [5] popularity in the information (the front desk applications) processing system like front desks or reception-oriented desks which defines application of the system.

Robots are [7] human controllable devices/machines designed for various uses in variety of fields. It may include hospitals, hotels, and institutions. There robots are artificially made machines where an intelligence is provided to it.

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The information required for processing the specific task assigned for the robot is fed in it for proper usage. It can be fitted with sensory system/devices, which can sense the objects, things, humans nearby it.

Based on the survey on receptionist robots, they are used for working as a receptioner for an institute, can be used by the company to welcome the visitors, and even can act as a supervisor's [4] in guiding the person in work to be done.

A receptionist robot is conceived with the [8] purpose of driving the existing visitors to a given site, providing a variety of information about the place or by helping the visitors to reach any desired location within the premises can be done by giving them directions. As of robotic function is portrayed, it requires to work within a "human environment", for the human robot interaction to be implied. In order to facilitate human robot interaction, [9][10] the robot should present some human-oriented features and proportions.

Significant improvement in the field of robotics paves way for expansion of continuous advancements in the field of technology. Specially, focusing on the receptionist machines can be regarded as the most [3][13] socially interactive robots, which is defined as the important mark-up for the implications on human to robot communications. It can detect the person image and can recognize using Haar-cascades using computer vision. Google speech system [5][9][10] can be adaptable for the synthesis of voice process. It defines the direction management system that can be used for tracing the defined route and finding the way. It is used in assisting people by providing them with the place of their interests with the [8] proper directions necessary for their guidance. A variety of works are explored for the domain with differential solutions for trace route and audio skills as ultimate optimal solutions.

A few applications areas where the robot receptionist is defined:

- Works as a receptionist for booking rooms in hotels as hotel service robots.
- Acts as a guide in guiding directions for the guests in finding way for their places of interests.
- Can do the job of the receptionist at an office or an institution to welcome the guest and to interact with them and to provide detail information about a particular aspect.
- Used in automation systems, entertaining perspectives.
- Application in hospital to maintain the record the patient records.
- Used as a learning agents for teaching children under the age 4 to 5 years.

Robot Receptionist

A mainframe working of a robotic receptionist defined:

- A receptionist designed with the computerized guidance to work at the reception. It works as a middleware for the platform.
- It is designed to remain stable until it gets signal by server connected to the robot.
- After signalling, it detects and/or recognizes the visitor and makes a move to welcome them.
- It can interact and ask visitor for the purpose of visit by intimating the message to the concern person.
- Once response provided by concern person robot takes visitor to respective person they want to meet.
- Finally, it bids off the visitor by thanking them.

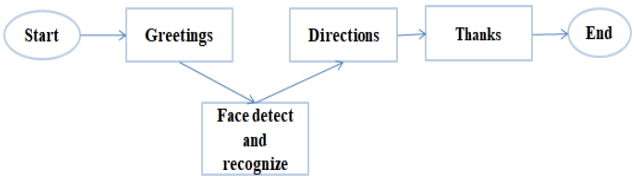

Fig.1: Block diagram of receptionist working.

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II. RELATED WORK

A review on various literatures has been defined to know the work that has been done for analysis of robot receptionist.

A. Interaction

The human and machine interaction [1][9][10] to be comforting with a various communicational aspects is defined. Michal Podpora, et.al defines analysis to make the robots friendly and welcoming with the help of the experiments performed on short verbal interactions between the humans and the robot. The system was defined to be natural and it can be used to localize a person while interacting with the robot. [2][5] Interaction is made efficient by means of the touch sensitive device for human and machine interference in means of communication. It was well programmed and the interaction was easier for the complex actions and the response. Non-verbal communication for context aware gestures and a comparative knowledge on human reaction using artificial intelligence engines are to be not defined.

Interacting with the children to provide them a home environmental scenario to learn their subjects with the help of a robotic teacher [6] is defined by Fumihide, et.al. It is a personal robot developed to provide a remote classroom for the children to learn alongside of the robot learning agent. It serves as an educational material and also as an educational agent for providing instructions and supports them in learning the concepts.

This encourages the children to learn for [6] long time without getting bored with the robot teacher. It creates a triangular atmosphere for designing an interactive sessions. Human interaction with robot can be define tactically or orally in the interface, used to guide the visitors in finding their way of place.

In servicing systems robot interacting with the user is at most important. Welcoming them, [8] interacting to provide a right instruction and details about the describe place or the location, answering to the questions raised by the users are to be defined for the receptionist.

Participation of robot receptionist in working with groups or in in team works by guiding the customers or the users or the employee in their work needs a human robot interaction to be a multi-step process. Based on the experimentation by Nadine, et.al, robot working as a receptionist was rated with highest satisfactory and also effective participation of robot was given a positive response.

B. Movement Management

A Robot designed with the motors [1] and the omni-directional wheels to enable the range of movement and due to anti-colloidal built-in system, it can detect the people or can risk collusion with the obstacles in the way of motion. It can localize a person while interacting with the robot. Based on the sensor used it can track down the human with a certain level of distance [11].

Defines a [2][8] navigational toolkit which performs tasks autonomously with the help of the laser information data useful for robotic navigation and finding the location. It serves the purpose of navigating to estimation position using maps generated or the data that is feed in the system statistically.

Map based generation and navigation [14] is defined in the system to move to the particular path with the hand-made maps are taken as reference. These locations plotting can be done by using the names of places or by plotting pin-points positions.

A graphical navigator [8][14] function is defined to provide the true positions and logger to generate the maps when the system is running autonomously. It uses two wheels and motor pulses are defined in meter per second and speed of rotation is defined with pulse multiplied with velocity of speed at which rotation is taken place for two wheels is divided by 2 factors. But the system was projected to some positioning errors and encountering obstacles in the way of path made it easy to detect to make a move to specified location and plan for a new trajectory by avoiding collisions.

The distance [8][11] of people is measured in pixels and values obtained by position are defined in meters using a curve fitting tool.

C. Face Detection and Recognition

Based on the interaction robot can [1][5] detect faces and can interact with the person by reacting to the person based on what they are talking. While, [6] the robot teacher detects humans or objects within its premises, a safety

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controls are activated using sensor defined. As a face tracking function for activating and deactivating of the tracking function is extremely very sensitive and a hard problem, hence the robot teacher does not include the built-in face detection or recognition and the tracking functions. As it's a crucial function, combining the face tracking with sensors is defined.

Human interaction [2] with robots is improved as the detection of face is needed to be provided for proper eye contact with the robot designed. The version uses the Open Computer Vision algorithmic software for face detecting. For the purpose of reducing number of the false detections, face detectors is defined to detect one or more faces in three different frames and returns true if the face is detected and number of false detections are decreased. [5][9][10] Open CV detector is capable of identifying multiple number of faces in a single frame, and the face that is closest to the robot is detected as it only focuses on the specific person and rest of all are singled out. The person holds the highest radius defines the one closest to the robot.

The detected face corresponds to its coordinates of the image and the radius that is approximated by choosing the closest face that is nearer to robot. The process of differentiations between the original and the filtered algorithms defined is processed subsequently. The modified Open CV algorithm [5] produces the positive impact by reducing the number of false detection of faces using two-dimensional Gaussian filters. Experiments made on both algorithms by using manual detection of faces and comparing it with original Open CV [12] software and the modified version of Open CV filtered algorithm presented as, tests conducted produces an accuracy of 88% for original algorithm and 83% for filtered.

The algorithm detected less number of false detections and it is noise resistant, it provided extremely good impact for the people detecting using [8] software system detection rather than the manual application. As it is performed around 1/3 of the people detection, it was not much adequate and cannot detect the person passing by is defined very low. And what can be the next move can also be defined in the design using unified machine level interface.

Vision [3][12] is used to provide interaction process and to analyze the visual input details to leverage a great impact on the human stimuli for the robot to respond. Vision of the robot is used to determine the human recognition and object recognition.

Human recognition (HR) [3] is used for extracting semantic features based on the facial expressions and using the Open-Pose Real-Time Pose Detection library, which provides the pixel locations of the body with selected key points for each person in an image. Michiel et.al, describes an architectural review of robot to detect human includes a master node and two other externals nodes, which process image through the camera using Open Pose Vision pipeline with the list of humans along with their body key points. Another node is used to examine the each person body points and process these data to provide useful semantic information that helps robot in making decisions.

Using the posture information by mapping the body points from two dimensional or three dimensional coordinates in a real world space based on the depth camera are generated.

The extraction of three dimensional semantic features of each human can be determined based on their distance from the robot and the height of the human. Even provided with the face tracking mechanism that allows to extract the semantic features of the each individual human using Open Pose Strategy can enhance the interaction capability with the human and the machine interface.

Object recognition (OR) [3] , is used to serve the social robots, was effectively determined to respond the commands that required in identifying objects, like for example, 'find me a bottle'. In order to do that, a robot needs to recognize the generic class of objects such as 'bottle'. A key point-based object detection algorithm was described. Moreover, efficiencies of key point-based object detection algorithms motivates in integrating additional algorithms. Most importantly, the algorithm recognizes particular instances of objects rather than the general class of objects.

On the other side Deep Neural Networks [5] are used to train to detect generic class of objects and to analyze the performance using both You Only Look Once (YOLO) algorithm and Faster R-C Neural Networks (R-CNN) on defined robot receptionist. In real time application, robot can interact with the arbitrary class of objects. Investigation on neural networks responding to novel objects need to be defined. COCO Datasets are used on which the neural nets are trained to classify the objects based on COCO labels.

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D. Speech Process

Microphones [1] are used in four directions inside the robot to define the voice process in the system. Robot not only interacts with the voice generation or by displaying actions on the tablet/phone, but it can interact through gestures in some systems. Image corresponding to the voice was not recorded. As the interaction is long term between the robot teacher and the [6] children verbal answering and communication or by touching the display to answer the questions with the speech application Interfaces are defined. Due to long conversation defined speech/ voice defines a important aspect in the system.

Based on the robot verbal form of expression, [6] that may cause manipulation in the voice pitch or the words being pronounced. In that case, a natural sounds mechanism need to be provided for the robot for overcoming the process. The choice of words or phrases chosen needs to be ensured with high effectiveness.

Lack of voice recognition system [2] of robots that cannot understand the verbal expressions of user participants. Even if the voice system is sophisticated, robot can understand the human verbal communication but it remains a challenge when human response is not compatible with robot interaction.

Robot acts freely without any influence on the system called as autonomous mode, where every speech/voice process can be taken care by the [5] Google Speech API. It requires a high quality rich set of data and answers to properly engage in natural conversations with the robot interaction. In order to achieve it a programmer need to try all possible ways cloud service solutions to program the experiment that grows for longer and to be much complicated. [4] Movement and word phrases are pre-programmable called non-autonomous. Some of the operations are controlled or guaranteed by authority, employee or the standardized representative. This behaves proper but looks like a human to human interaction rather than a machine to human interaction.

To overcome two forms are defined as to [4] standardized behavior of robot to ensure internal and external validity of the system or to interrupt the random robotic mistakes, and can quickly respond to both verbal and non-verbal forms of expressions which can improve the natural flow of speech process. The system or the operator called semi-autonomous is used to preprogram answers used for verbal communication.

To identify the weakness and strength of robot's in-built speech recognition [2][9][10] and the existing software is augmented with cloud-based speech recognition that improves the robustness and the accuracy of robot's speech interaction. Furthermore, it has developed robot with the capability to learn better to recognize speech as it variety experiences social interactions.

To measure the accuracy of [3] speech recognition in the system with reproducible and valid comparisons, studio microphone is used to record the tested sentences and replay it with high quality fidelity speaker that will be located at certain place for robot. Robot provide with the built in speech recognition software that defines a compact speech as a solution for embedded systems. Users are able to input the vocabulary of the phrases that are to be recognized, it only matches the exact phrases with confidence level. Base accuracy used to define the grammar that are large and accuracy defined can be very low.

A cloud based streaming for speech recognition a Google Cloud Speech [3][9][10] is defined to connect real time. Google Speech Algorithm includes [5] Deep Neural Networks that includes trained data with large amount of data collected from the users, and able to recognize speech generally. Microphones are used to improve accuracy and to recognize speech at any angle with highest confidence.

Multi-Modality [3] is defined as one input method is unreliable, robot can actively requests input through a different modality from the user.

- Alternate set of inputs are provided.
- Failure Tolerant using Modulation Selection
- Recognition of the activity patterns
- Collection of data
- Learning of motional patterns

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III. METHODOLOGY

The designed system represents overall process of the proposed work as follows with the modular description defined.

A. System Design of Proposed work

A robotic receptionist is designed, which can do the job of a receptionist in a college or a institution or office. Robotic receptionist can sense the visitor or customer and welcomes them once they reach the office. The receptionist is fitted with a Raspberry Pi and HD camera and used artificial intelligence with the Natural Language Processing into it for the natural speech. The receptionist can welcome and interact with the visitor.

The receptionist can ask the visitor the purpose of the visit and based on that it sends a request to the concern person or authority. The requested person gets the notification into the android phone and can send the instruction to the receptionist. The receptionist, convey the message to the visitor.

The visitor can follow the receptionist to reach the concern person. The receptionist can capture the image of each and every visitor and welcomes them automatically from the next visit when the same visitor or the client appears again.

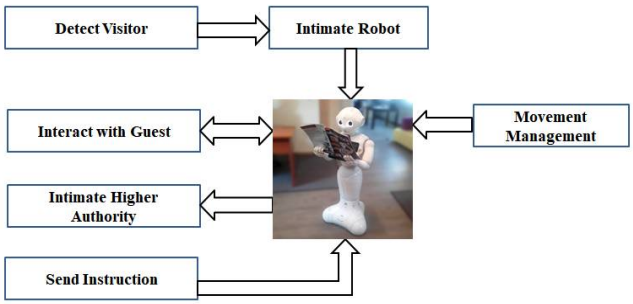

Fig.2: Architecture of Robot Receptionist

B. Modules

Defining the implemented modules with the description of each by their process of working is as follows:

1. Admin

   A concerned authority to instruct by inserting the details required for various services, about the details of the college/ institutional/ office services that are useful for the employees, students or the clients or guests or the visitors visiting the respective place. All these information are stored in the robot so that it is trained as a receptionist to interact with the visitors, by answering their queries and provide the informed about their request to meet the concerned person.

2. Interaction

   Once the visitor enters the office, Robot welcomes and starts interacting with them. It takes the input from the visitor and the speech of them is converted into text using Google TTS and applies NLP. Based on guest's query it replies and intimate the concern person. Once the concern person gets the notification, they send the instruction to Robot. All the conversations are stored in the server. Based on the instruction from the concern person it convey the message. Robot captures the image of all the visitor with their details and transmit to the server.

3. Movement

   The department consists of few routes and each route contains several points. Based on the instruction, the Robot selects a particular route and moves in the route. It starts from the first point of the route and moves

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Vol. 7, Issue 4, April 2019

towards next point on the same route. It changes the direction from a point while moving towards the next point based on the predefined instruction.

4. Detect visitor

   The Robot is placed in the reception. When any visitor comes inside, the detector detects and send signal to the Robot. As soon as the Robot receives the signal, it moves towards the entrance and welcomes the visitor.

5. Another visit

   As the Robot captures the face images of each visitor along with their details in the server, when the visitor visits the office again, it captures their image and sends to the server. In the server, the image is processed and apply the face recognition algorithm. If matches found, retrieve the previous visit information and based on that it starts interaction.

IV. RESULTS

The final analysis of the system is represented with the output obtained by designed product.

Fig.3: Capturing the image

It describes taking an image when the person is near to it by notified signal that is sent from the server to the robot to allow for taking picture. Once picture is taken it is displayed as in Fig.3 given.

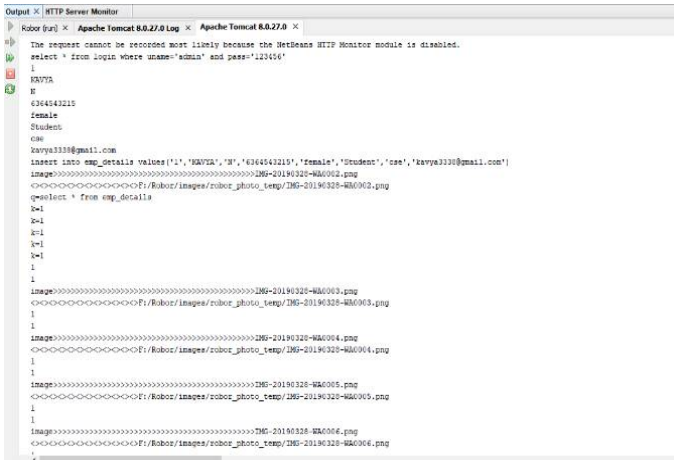

Fig.4: Storing client details in database with the captured images

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Defines the details of each and every person visited are stored in the database in Fig.4 for the further process when the person visits next time.

```
select * from login where uname='admin' and pass='123456'
01
kavya reddy
n
6364543215
female
student
cse
kavya3338@gmail.com
insert into emp_details values('01','kavya reddy','n','6364543215','female','student','cse','kavya3338@gmail.com')
image>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>8.png
<><><><><><><><><><><><><>F:/Robor/images/robor_photo_temp/8.png
path==F:/Robor/images/probes/01_1.png
>>>>14
number of heads= 1
******0
R.x..14
R.y..16
R.x+R.width=39
R.y+R.height=39
Original Image Dimension: 70x70
Cropped Image Dimension: 39x39
Image cropped successfully: F:\Robor\images\temp\01_01_1.png
```

Fig.5:Image cropped successfully with face detection

Each and every person's image is cropped to prescribed size in Fig.5 and stored to detect faces properly with its defined resolution.

```
Apache Tomcat 8.0.27.0 Log ×   Apache Tomcat 8.0.27.0 ×   Robor (run) ×   Robor (run) #2 ×
Client response: deviceconnected
4
>>>>>4
Client Connected
Client response: deviceconnected
>>>>>
Client Connected
Client response: deviceconnected
>>>>>
Client Connected
Client response: deviceconnected
>>>>>
Client Connected
Client response: deviceconnected
>>>>>
Client Connected
Client response: deviceconnected
3
>>>>>3
Client Connected
Client response: deviceconnected
>>>>>
Client Connected
Client response: deviceconnected
>>>>>
Client Connected
Client response: deviceconnected
>>>>>
Client Connected
Client response: deviceconnected
>>>>>
Client Connected
Client response: deviceconnected
4
>>>>>4
Client Connected
```

Fig.6: Device connected

When a client and the device is connected then the response provided makes the robot to move in the defined direction as 4 to be thanks, 3 as deny.

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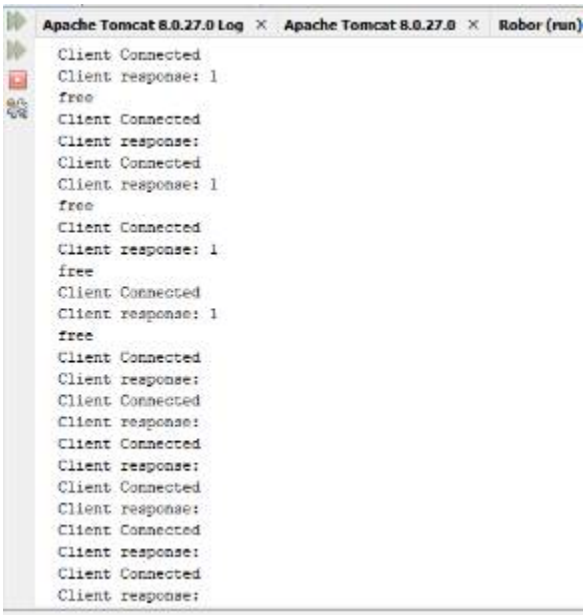

Fig.7:Client response

Defines the client connected and its response as when 1 as free as shown in Fig.7.

Fig.8: Face matched

Once a person has visited another time then the robot defines as the person image is matched with the details in the database and displays as face matched in Fig.8.

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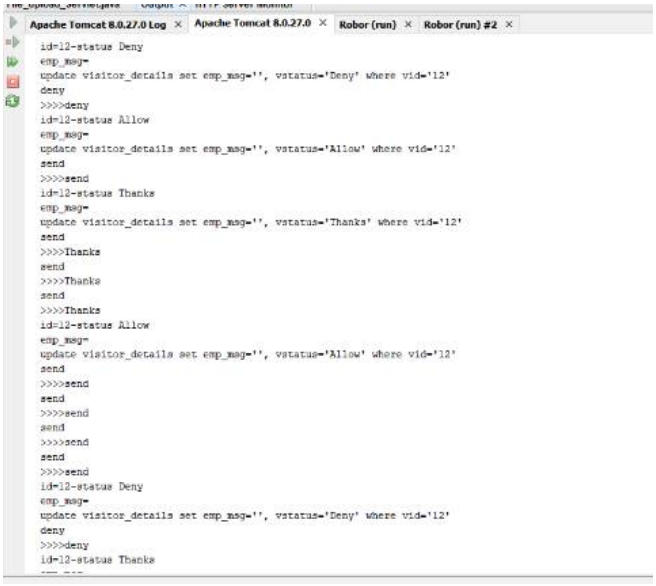

Fig.9: Robot status

Defines the status of robot, what are the processes it can perform in Fig.9.

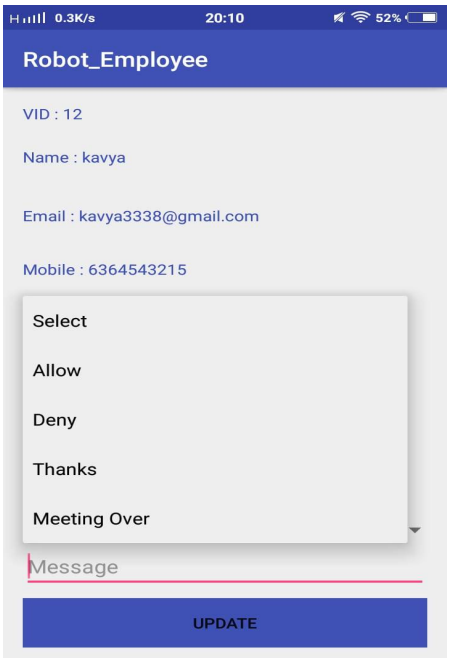

Fig.10: Authority response

The response of the authority in charge responding the robot with the following commands defined in Fig.10.

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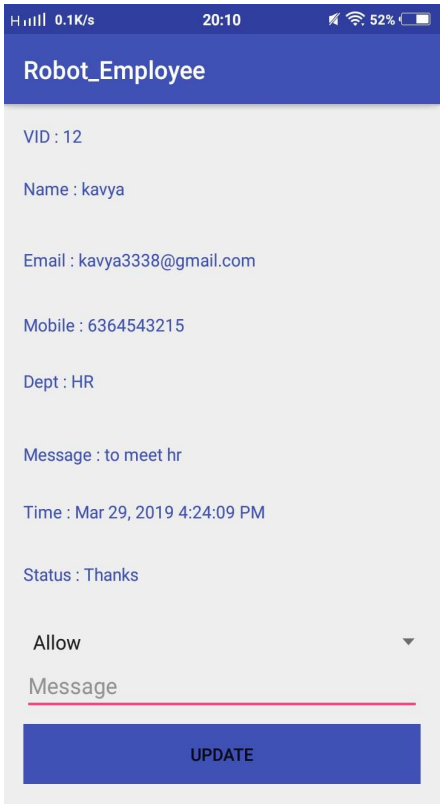

Fig.11: Visitor details

Defines details of the visitors and the respective person whom they want to meet is updated as shown in Fig.11.

V. CONCLUSION

The design descripted is well suitable for the information systems and can help the robot to do the job of the receptionist. Proposed work defined with movement for motion management for directing the visitors and a model with trained information that a robot can understand to interact with visitors and Haar-cascades algorithms used to detect and recognize faces are defined with proper accuracy was satisfactory. Next visit of the person can also be recognized properly. The proposed and defined extension has proved to be properly efficient for natural processing of speech and the details of person's data can be stored in the server. Finally, it defines working of the model in institutions or office spaces as a receptionist.

Further, multiple people/visitors detection and recognition and multiple speech process can be the future work of the system.

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