

# SMART AUTOMATED ROBOTIC ASSISTANT

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**Abstract-** In a modern household, the house is left locked until the family returns in the evening. Leaving the house alone can lead to situations like burglary or gas leak which can cause serious damage to life and property. A newborn child creates challenges in a family, especially where both of them are working parents. In this paper, a virtual assistant system is embedded to a robotic device implementing some of the crucial electronic equipments required in a modern household. An intelligent virtual assistant is a software agent that can perform preprogrammed tasks or services based on several commands. The implementation of a robotic body for the virtual assistant system enables S.A.R.A (Smart Automated Robotic Assistant) to move around the household to implement these devices and thus reducing the amount of hardware placed around the house. S.A.R.A. consists of features like anti theft alarm, baby monitoring system and gas detector. It operates on voice commands, as well as through Android platform devices. This helps the users to vocally control the device or through their Smartphone.

**Keywords-** Artificial Intelligence, Machine Learning, Face Recognition, Automation

## I. INTRODUCTION

Smart automated robotic assistant s.a.r.a is an artificial intelligence developed using raspberry pi for face detection and obstacle avoidance. SARA has an inbuilt Amazon Alexa SDK, which runs on a Raspberry Pi 3. Alexa SDK provides an opportunity for SARA to act as a Home Assistant. Alexa can communicate to normal commands such as "alexa how is the weather" and customised commands "alexa follow me".

SARA can be an example for a personal assistant that can come around with you even though there are only a few with the desired characteristics as SARA. SARA is equipped with a camera and a mic to understand its environment. It is able to recognise people it has come in contact with and doesn't react with strangers.

Other important features include LPG gas detection, Baby monitoring and night anti-theft mode. Services like LPG gas detection are added to help old age parents who have memory problems like Alzheimer's. New parents can find the baby monitoring system really comfortable as they can ease of mind when baby is sleeping. If there are sudden movements or sound from the baby an alert is send to the parents mobile. Anti

Theft mode is activated at night. When unusual movements are recorded in the house at night an alert is send to the mobile.

## II. METHODOLOGY

### Software configuration:

In this project, we are creating an Alexa-based robot for voice commands. Alexa is an open source speech recognition software used by various developers all over the world. For that, Amazon Alexa software is put on the Raspberry Pi which controls the operations of the robot.

This Alexa-based robot works by using a few services strung together:

- **AlexaPi:** We use Alexa Voice Services to listen for commands, using the AlexaPi project software. This setup consists of microphone and speaker for audio input and output. Alexa Voice service is used to access cloud-based Alexa capabilities with the support of hardware kits and software tools.
- **IFTTT:** This passes the data to If This Then That. If This Then That is a freeware web-based service used to connect different apps and devices. The software is used to communicate with the connected nodes.
- **Ngrok:** We connect back to the master node ie; Raspberry Pi using ngrok service. Ngrok is used to channel HTTP traffic to a network device without using a fixed IP address.
- **Flask:** Flask is a micro web framework which is used here as a server. We listen for commands, and control the robot using a python program with the help of Flask sever.

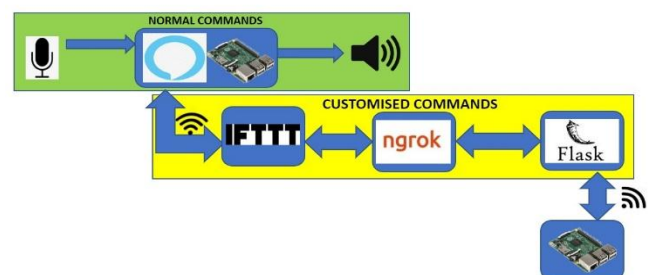


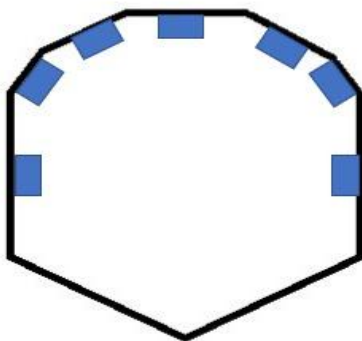
Figure 1: block diagram of Alexa-based communication system

**Follow me logic:**

The main advantage of S.A.R.A over other Virtual Assistant devices like Amazon Echo is its transportability. S.A.R.A does not have to be carried around as it is capable of moving around the house with the user. **“Follow Me”** command is used to make the robot follow the user around the house.

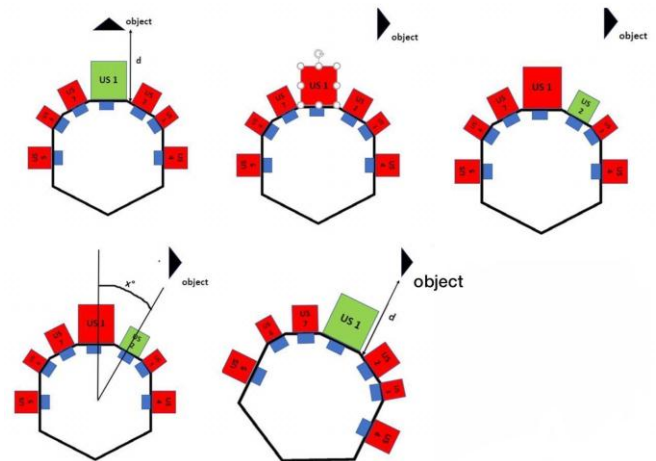
At first, the user that controls the device is assigned using face detection. The camera scans the face of the person executing the command to verify the user. Once verified, the device assigns the user as the primary object. Then the robot follows around this primary object.

The body of the robot consist of 7 ultrasonic sensors placed at slightly different angles for getting 180° angle. Figure 2 shows the placements of these ultrasonic sensors. Each sensor is placed at an angle of 30° to its adjacent sensor.



**ULTRASONIC SENSOR ARRAY POSITIONS**

Figure 2: Positioning of ultrasonic sensors on S.A.R.A



The working of the follow me consist of the following steps:

- ❖ When the command is passed to the robot through vocal instruction the camera scans the face to identify the user.
- ❖ When the user is detected, the ultrasonic sensor specifically ultrasonic sensor 1 or us1 measures the distance between the primary object (ie; the user) and sensor (a) ( Note: the green box indicates that us1 has detected the object.).
- ❖ When the object turns in a direction say, to the right as in (b), us1 is no longer able to detect the specified object.
- ❖ In this case(b), us2 has detected the object. The camera with the help of face recognition identifies if the person detected by ultrasonic sensors was the person it was supposed to follow.
- ❖ If the answer is yes (c), then arduino mega finds the angular difference from us1 to detected ultrasonic sensor value , here it is us2 . It denotes the angle x.
- ❖ The bot then rotates itself with the angle x until us1 detects the object (d). It then maintains the specific distance d.

**Baby monitoring system:**

Baby monitoring system helps to detect distress of a baby which was left sleeping in a crib. The robot monitors the crib and surrounding activities to detect if the baby has woken up or crying. A PIR sensor is used to detect motion around the crib when the robot is nearby. The PIR sensor detects infrared radiation from objects around its field of view. So an uneven motion around the crib suggesting that the baby is awake can be detected by the robot. The onboard microphone in the robot detects when the baby starts crying. When any of these situations are detected, the robot sends a notification to

the mobile application that is connected with the network of the device.

#### Anti-theft alarm:

When the anti-theft mode is activated, the robot constantly scans its surroundings for motion with the help of the PIR sensor. If and when a motion is detected by the robot, it scans the face of the person and runs the face detection algorithm to identify the person. If the person is unknown, Alexa sends a notification to the Smartphone application saying that an unknown person is detected in the house.

### III. SELECTION OF COMPONENTS

Components Required:

- RASPBERRY PI
- ARDUINO
- ULTRASONIC SENSOR
- GAS SENSOR
- PIR SENSOR
- IR SENSOR
- PORTABLE CAMERA
- SPEAKERS
- MOTOR DRIVER
- DC MOTOR
- MICROPHONE

#### 1. RASPBERRY PI

Raspberry Pi is a single-board computer which contains the basic components of a central processing unit. The ROM of the system is stored on an external memory card since inbuilt memory is not available. Unlike a generic CPU, Raspberry Pi has several digital and analog pins for input and output which allows to connect several electronic devices to be connected to it.

#### 2. ARDUINO

Arduino is a microcontroller equipped with sets of analog and digital I/O pins which is interfaced with sensors and Raspberry Pi. It is used to control a limited number of operations in a single board. Here, Raspberry Pi and Arduino board exhibit a master-slave relation where Pi processes the input values from Arduino boards and provides output actuation through the output devices connected to Arduino.

#### 3. ULTRASONIC SENSOR

The ultrasonic sensor uses the ultrasonic signals to find the distance. It transmits the ultrasonic signals continuously in limited time intervals and receives the transmitted signals. Thus, using these values, the microcontroller calculates the distance from the sensor

to the object. This is used for finding the water level in the water tank.

#### 4. GAS SENSOR

Gas sensor is a device used to detect the presence of toxic and combustible gases in air. It is used to detect LPG or other combustible gas leakage occurring in a room due to malfunction or carelessness.

#### 5. PIR SENSOR

PIR sensor is used to detect movement around the field of view of the sensor. It works by detecting and measuring infrared light radiated from objects around it. It is used to sense human presence to detect the user and the presence of a burglar in the absence of the residents of the house. This is, in turn, used to activate anti-theft alarm.

#### 6. IR SENSOR

An active IR sensor uses an emitter and receiver which detects presence and motion through the reflected IR signals. While PIR sensor detects general motion, an active IR sensor detects motion at specified directions.

#### 7. PORTABLE CAMERA

A portable camera is used to get the visual perception of the surroundings. The camera is used for collision avoidance, object detection and face recognition.

#### 8. SPEAKERS

Speakers are used for general sound output. The AI technology is programmed to deliver reply voice messages for certain commands. It replies success or failure messages after the completion or failure of the given task. The anti-theft system of the device can also be setup to sound alarm during a forced break-in or a burglary attempt.

#### 9. MOTOR DRIVER

The L298N is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic level and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor.

## 10. DC MOTOR

A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

## 11. MICROPHONE

An electret is a stable dielectric material with a permanently embedded static electric dipole moment (which, due to the high resistance and chemical stability of the material, will not decay for hundreds of years). The name comes from electrostatic and magnet; drawing analogy to the formation of a magnet by alignment of magnetic domains in a piece of iron. Electrets are commonly made by first melting a suitable dielectric material such as a plastic or wax that contains polar molecules, and then allowing it to re-solidify in a powerful electrostatic field. The polar molecules of the dielectric align themselves to the direction of the electrostatic field, producing a permanent electrostatic "bias". Modern electret microphones use PTFE plastic, either in film or solute form, to form the electret.

## IV. FUTURE WORK

Artificial intelligence is one of the bleeding edge technologies of the current century. It is still in a developing state and further modifications are required for the technology to reach its complete potential. Developments in the AI technology further helps to develop the project to add much more functionalities to the project. With proper technologies available at the time, this project can be upgraded into fully automated home automation and Security system. Since the hardware components like raspberry pi is very flexible, it is easier to add upgradations and hardware plugins to the robotic system. Further advanced speech recognition software can be used to make a fully responsive robot. But such AI can be quite heavy and troublesome for the current hardware components used. Display screens can be helpful to deliver messages for hearing impaired users. Mechanical arms can make the robot more physically work capable. With the current perspective of science and technology, there are vast possibilities and functionalities that are applicable to the project.

## V. CONCLUSION

This paper describes a home automation and security system that can be easily integrated into our daily lives. It keeps the house safe from some of the common yet dangerous threats from occurring in the absence of its

occupants. It enlists some of useful features like baby monitoring and gas detection which are very useful for a new household where the young house owners could be careless and unaware of such situations. Anti theft detection and alarms protect the house from unauthorised entry and face detection helps to prevent unauthorised use of the system. One of the most important qualities of the project is the simplicity in its interface. The robot can be controlled through voice commands or through an android device. This simplicity in operating the device allows it to be implemented in almost any families.

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