

# **IoT based Autonomous Home Assistant using Computer Vision**

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This Report Presented in Partial Fulfillment of the Requirements for the  
Degree of Bachelor of Science in Computer Science and Engineering

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**DAFFODIL INTERNATIONAL UNIVERSITY**

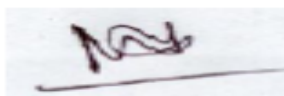
**DHAKA, BANGLADESH**

**JANUARY 2022**

## **APPROVAL**

This Project/internship titled “**IoT Based Autonomous Home Assistant using Computer Vision**”, submitted by **MD Sharif Khan, Md Jahid Hasan** and **Md. Masidul Hasan** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 17.01.2022

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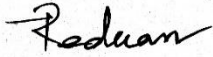
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## DECLARATION

We hereby declare that this project has been done by us under the supervision of **Md. Reduanul Haque, Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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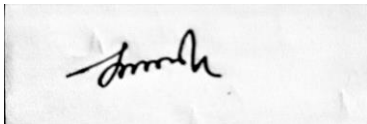
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## **ABSTRACT**

Robotics and Automation are popular subjects in recent years. Most of the modern technologies are integrated with automation. It makes our life more easier and comfortable in our daily activities. With the concept of automation we build a home assistant. With the help of a camera, sensors, actuators, motors we build a system that can help us in our day-to-day life. This is an IoT based autonomous system that can move freely and give different suggestions and results. Using different Application Programming Interfaces our system can provide us with different recommendations. For developing this home assistant we use an android device, using the camera of the android device our robot can move freely. Actuators and motors are getting data from android devices. Our AI also can detect humans and can follow them perfectly. It can follow orders smartly. For controlling robots and other components it uses an Arduino UNO microcontroller. This device used the HC-06 bluetooth module to communicate between android smartphone and Arduino UNO. Our smart assistant can be accessible for all kinds of users. It has a user-friendly interface and is also cost-friendly. We develop this as a way that in future we can add more features in it.

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# CHAPTER 1

## Introduction

### 1.1 Introduction

In this era of the 4th industrial revolution robotics and automation take a big place in human's day to day life. We depend a lot on robots and take a lot of help from automation systems. With the use of robotics, the productivity of humans increases a lot. A statistic said that 88% of industries plan to adopt robotics automation into their infrastructure. Now robotics has huge potential and in the future it will be a great and big marketplace. The current trend for automation is computer vision. Using computer vision automation technology goes one step further. Now computers can see and can make decisions by watching objects just like humans. Computer vision with robotics makes magical changes in the life of humans. Using computer vision a robot can detect objects and can identify the objects. Using this feature, the robotics industry created a revolutionary change. One more mind-blowing concept in the field of robotics is the Internet of Things. Using this technology/concept we attach multiple robots, devices or sensors. It boosts the work power of robots and gives humans the ability to control robots from anywhere in the world. IoT is the technology that makes a revolutionary change in all formats of robotics and automation. IoT is vastly used in the field of the medical sector, agriculture, house automation, traffic and many important sectors of our day-to-day life. In Bangladesh, the practice of AI is increasing day by day. This is the right time to grab the trend of AI. This field is increasing a lot day by day. With the help of AI we can do many difficult tasks that are risky for humans. AI can do that kind of work very easily without the interference of humans and any kind of human life risk [5]. The field of study is increasing day by day and we develop a lot of software with AI. Recommendation System, Fraud Detection, Autonomous car, Object detection, Anomaly Detection, Classification all are the practical use of AI. Those features make a great impact on our day-to-day life. In the recent future all the analog features of industries will be converted to automatic operable using AI. With the help of AI we are implemented a system that can help us in our daily life as well as in the professional field. As the improvement of AI our system will also capable of doing better day by day.



## **1.2 Motivation**

Using the concept of automation we want to create a multipurpose automatic device that can be used as a home assistant. From the need for a personal assistant that can follow a person, take commands from them and find some object for the person using this concept we are talking about to create a home assistant. A home assistant or a smart assistant is quite helpful for personal use as well as the industrial user. Many software/websites give suggestions using a recommendation system that is a part of AI. A smart assistant can make those smart systems more relatable for humans. To use AI technology more in our day-to-day life we are thinking of our smart home assistant. This will make our life easier and smarter. In the meantime from the concept of a campus car. That can easily move inside a specific area automatically and can detect and avoid objects efficiently. Image processing is widely used in industry and solves a lot of problems, most likely humans. In our daily life we also can use image processing/computer vision, which is also a major reason for this project. Using the concept of our autonomous campus car we can carry passengers to a university where dedicated roads are provided. Core features of our device are implemented with image processing. An automated vehicle can increase the productivity of an organization that has a big campus. An autonomous vehicle moves without a driver, an operator can operate multiple vehicles with help of technology. It saves time as well as money for a company. We can detect some abnormality from humans by a smart assistant, [4] this paper has a discussion about that.

## **1.3 Objectives**

Home assistants or autonomous vehicles are currently a hot cake in the field of technology. Many companies work with this technology and a lot of companies are trying to adapt to it. Not only companies but smart assistants are also used in the home. For personal purposes people use it. In smart assistants or autonomous vehicles, a lot of studies need to be done to improve their performance and accuracy. the much accuracy and features implemented by it, it will give more perfect feedback and work done by it will be more helpful for us. Using Artificial Intelligence, a lot of intelligent systems like recommendation systems, prediction systems, etc. are implemented. Recommended and Prediction systems are widely used in industry and also for personal use. Companies use

recommendation systems in their software to give a good user experience and also create more profit. The future of IT mostly depends on AI technology and an assistant can help you with AI in your day-to-day life as well as in industries. Autonomous vehicles are badly needed in the industry to carry goods as well as employees. Smart home assistants with automatic moving facilities will be a hot topic in the field of research and development. The use of AI is spreading a lot day by day. More work in this field will improve the performance and algorithm of AI. We will need to use AI in our day-to-day life. Now AI is used from rocket science to our home science. Using AI, we can make our life easier and more comfortable. An autonomous vehicle can save time as well as can make life easier while using transportation on a fixed campus. We can do a lot of work using smart assistants by voice command, object recognition or taking decisions by previous data. If we consider our country as our marketplace, a lot of big organizations and companies are building their factories and offices in our country. As they have a giant campus, our smart assistant and a smart vehicle can help them to build their office or industries more smartly. It can easier our life, save time and can improve human activities. The rules and technic of object follow and object avoiding system will be improved for making autonomous vehicle.

#### **1.4 Outcomes**

Our project is the current trend in this technology. Home assistant is just not for home, it can be used in offices, factories and educational institutions. Our autonomous device can move freely, can detect objects and make decisions. All those features can help an organization or institution to improve their productivity a lot. A smart home assistant can do a lot of smart work. Also the security system can be handled by our smart assistant. Through the calculation of a lot of parameters, it can detect an earlier danger and can give a signal to the authorities. It can follow specific objects and can avoid objects if desired. It can work with voice commands also. Our Smart assistant can detect objects1 it can take decisions automatically. It can move based on outcome and avoid obstacles. Our assistant can also follow the owner or the face we wanted to follow. This also can say how many people are in front of it and whom it knows from them. If in case it doesn't know any one of them it will automatically ask his name and after that it can detect that person and can

call him by his name. It can warn you if there is a possibility of rain outside. It can remind you about time and can tell you the time and date. It can help to know where you are (location). Ultimately we are making a smart home assistant that will help us in our day-to-day life and can learn new stuff on its own. It will give us notifications, alarms that can also be used as an IoT device. In the future, we will enhance this robot that can be used as an autonomous vehicle. It will move inside a restricted area by a specific route. Using computer vision our vehicle can avoid obstacles, maintain road lanes and can detect destination paths. It will also have the ability to detect the hand's sign of humans and stop cars in front of them. For education it can help students to expand their knowledge about Robotics. Our app will have some features that can be usable for only the learners. Learners can be able to change features and learn more by exploring them. [6]. In future this trends will capture the whole globalization. Big companies will follow and take help of the autonomous vehicle and assistant. Our object following and avoiding objects are the preliminary steps of autonomous vehicle.

## Chapter 2

### Background

#### 2.1 Related Works

A lot of work related to a smart assistant is happening now-a-days. Big companies like Google, Amazon, Microsoft are working with smart assistants. Alexa, Ubetech, Vector etc. are popular smart assistants at the current time. Those smart assistants are capable of helping in our daily life as well as in our professional life. A lot of papers are also published at this time. More analysis and research are helping us to make it more perfect and helpful for humans. [2] This article discusses how much Alexa performs correctly and suggests some improvements. [1] Here suggest a smart assistant that gives a smart solution of identifying and locating furniture of the home. It focuses on smart shopping awareness. [3] This article shows us how a smart surveillance device can provide video footage to the mobile surveillance team. A lot of research work is held for improving smart assistants. We read a lot of articles about our project for better output from our robot.

#### 2.2 Comparative Analysis

Current existing smart assistant robots are more expensive and not affordable for most of us. And most of them are not movable and cannot detect any person. Here we create a robot that can move freely using detection objects. Also we aim to build this robot within our range, not to add unnecessary features and devices inside it. Our robot mostly depends on computer vision so we are not using unnecessary sensors. We can also use our robot as an autonomous vehicle. In a certain area or road our smart robot can move. By analyzing photos, video our robot will provide feedback. Most of the robots use sensors to collect data. We mostly use image processing for collecting and analyzing data. Our smart assistant can predict and give alerts based on several data.

<b>Author</b>	<b>Title</b>	<b>Description</b>
Chen, Chia-Chen	A smart assistant toward product-awareness shopping.	This is a smart shopping system. Where a lot of sensors but in our system we don't use any sensor but working with computer vision.

Seymour, William.	How loyal is your Alexa? Imagining a Respectful Smart Assistant.	This is a report where they calculate the accuracy of Alexa. But we have a system like Alexa.
Kuang, Hao, et al.	A real-time smart assistant for video surveillance through handheld devices.	This is a project where analyzing video and predict the occurrence. Our project do something like this but it also have an ability to move and support.
Eren Demir, Erdem Köseoğlu, Radosveta Sokullu, Burhan Şeker	Smart Home Assistant for Ambient Assisted Living of Elderly People with Dementia	In this system collect data from different sensor and store them. But our system store data as well as give analytical result.
M. Al-Amin and S. Z. Aman	Design of an Intelligent Home Assistant	This project is based on face recognition and remote control home automation. In our project we also use movable vehicle and AI.

Figure 1: Comparative Analysis

### 2.3 Scope of the Problem

Our robot can be used in the home as well as in the industry. It solves a humans' day-to-day problem. It can give alerts and can give notifications. Many tasks will be automated using our smart automation system. As it can move automatically in the industry it can be used as an autonomous movable vehicle. Our smart assistant can give weather reports and can also be used as a surveillance camera. In educational institutions there are a lot of places where we can use this robot. It can ensure the security of students, help students to learn more efficiently as well as encourage themselves to develop and update this technology in the future. In industry automation can help to increase productivity. Employees will get updates from time to time and also get a lot of help from this autonomous system. It will be a great personal helper for autistic people. Who is not able to do all of his work can do a lot of work by voice command or image sign or through mobile command.

# Chapter 3

## Requirement Specification

### 3.1 Business Process Modeling

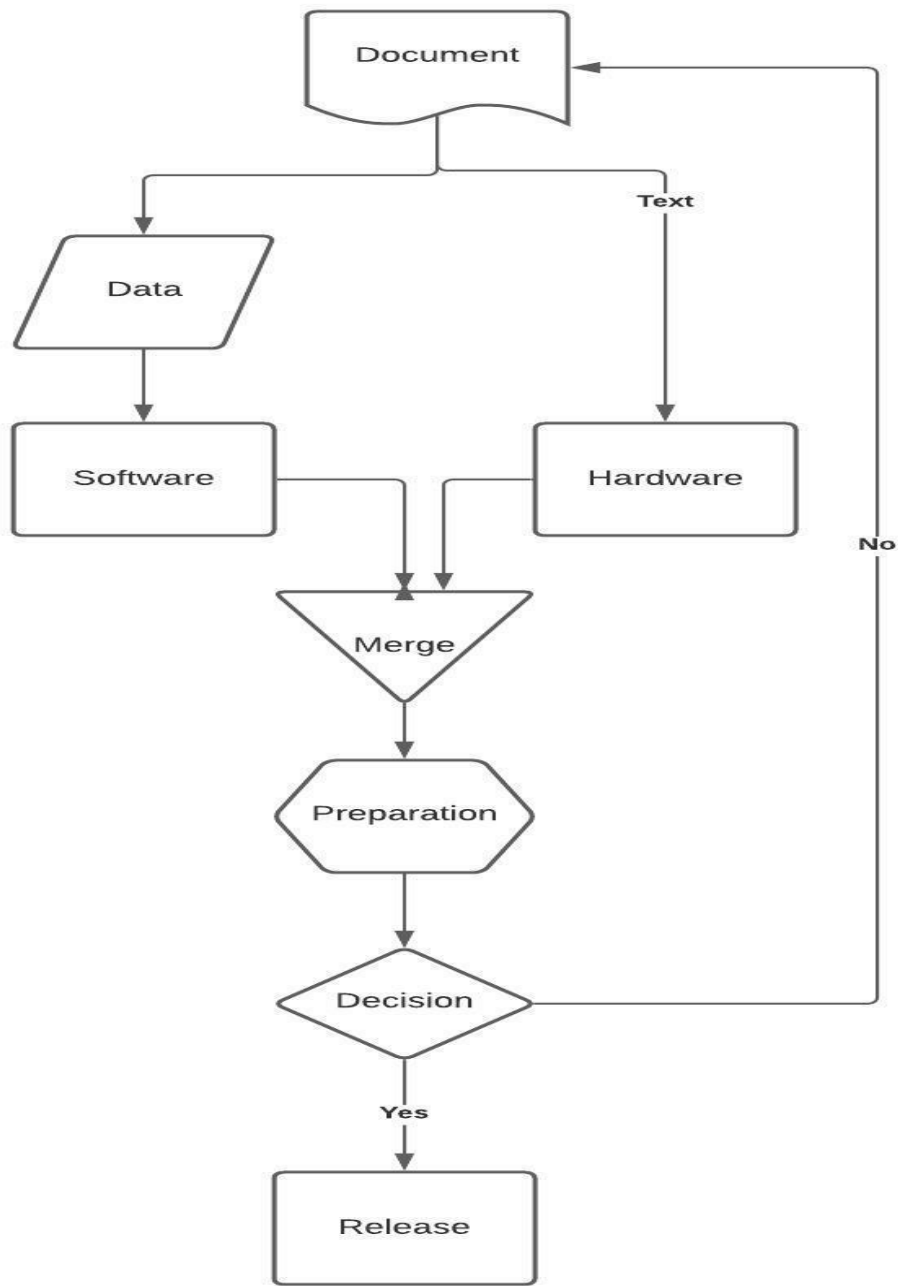


Figure 1: Figure of Business Process Model

Our robot has a great demand in the field of business. We will make a production-ready version of our project. After completing our development version we go forward with production. First analyzing our document we divide our work into the software and hardware section. Both parts are implemented by experts. After completing our tasks we merge them and prepare ourselves for testing. After testing if we succeed then we go for final production. If we need to fix something then again go for our document and update something, update our hardware and software and so on. We develop our product as middle-class people afford our product. Marketing is a big thing for promoting a product. We sure have some plans for marketing.

### **3.2 Requirement Collection and Analysis**

Based on people's needs and from our personal experience we collect our requirements. Some requirements are,

- (1) Alert us important time,
- (2) Follow someone,
- (3) Know some strangers
- (4) Room safety,
- (5) Important reminder,
- (6) Object detection,
- (7) Movable by avoiding the object
- (8) Voice Command
- (9) Give prediction/advise

After collecting those requirements we complete a deep study to implement this. Our AI model needs data to give correct predictions and it also collects continuous data to make the model so accurate. For giving important alerts we need to use google API. From Google calendar our smart assistant gives alerts and also by analyzing data it predicts data and based on data it provides important feedback. We need to make a deep learning model for object detection and object recognition. We use the You Only Looks Once(YOLO) algorithm for and dataset for the efficiency of our system. For prediction and advice some cases we use data from different sources like google, website and other 3rd parties. And

also we use our custom model to predict and give personal feedback, prediction and analysis. We also use a voice control system that can recognize the voice and can make decisions based on voice commands. We also have a feature that can store data of house members and if unrecognized people enter into the room it gives an alert to our IoT device. We also have our future. We can add a lot of features in the future. Take all the possibilities into account when implementing and analyzing our features.

### **3.3 Use Case Modeling and Description**

Our projects can be used by different types of users. For different types of users we give various facilities. For personal use our users can get facilities of personal preference suggestions. Home security is a very important feature in our project. From our home assistant a person can get personal notifications from a personal device and also get messages, suggestions, predictions and advice by using our machine learning model.

Our smart assistant can be used in industries. In that case it provides a solution that can help in the aspect of the business. Based on company policy it can give business ideas and suggestions. It can provide employee status and current status of employees and also can give us the status of projects. In-office or industries it provides office safety and can give alert of upcoming danger. By analyzing employee data it can give us an employee's working status.

Another important use of our robot is autonomous vehicles. our vehicle can move and get to the distance without human interference. Our robot can also be turned into an autonomous vehicle. Through a lane it can go to the destination. Also it can detect the hand signs of humans and base on the hand sign it can give the response. On user can register and command a robot. Our robot only listen the command of the registered user. With registration or sign in our robot will not take any command from user. It is must to register for operating our robot. On user can search query from robot with voice command. A user can also control the speed direction of robot in case of manual controlling. Our robot can give prediction by measuring different parameter from the internet.



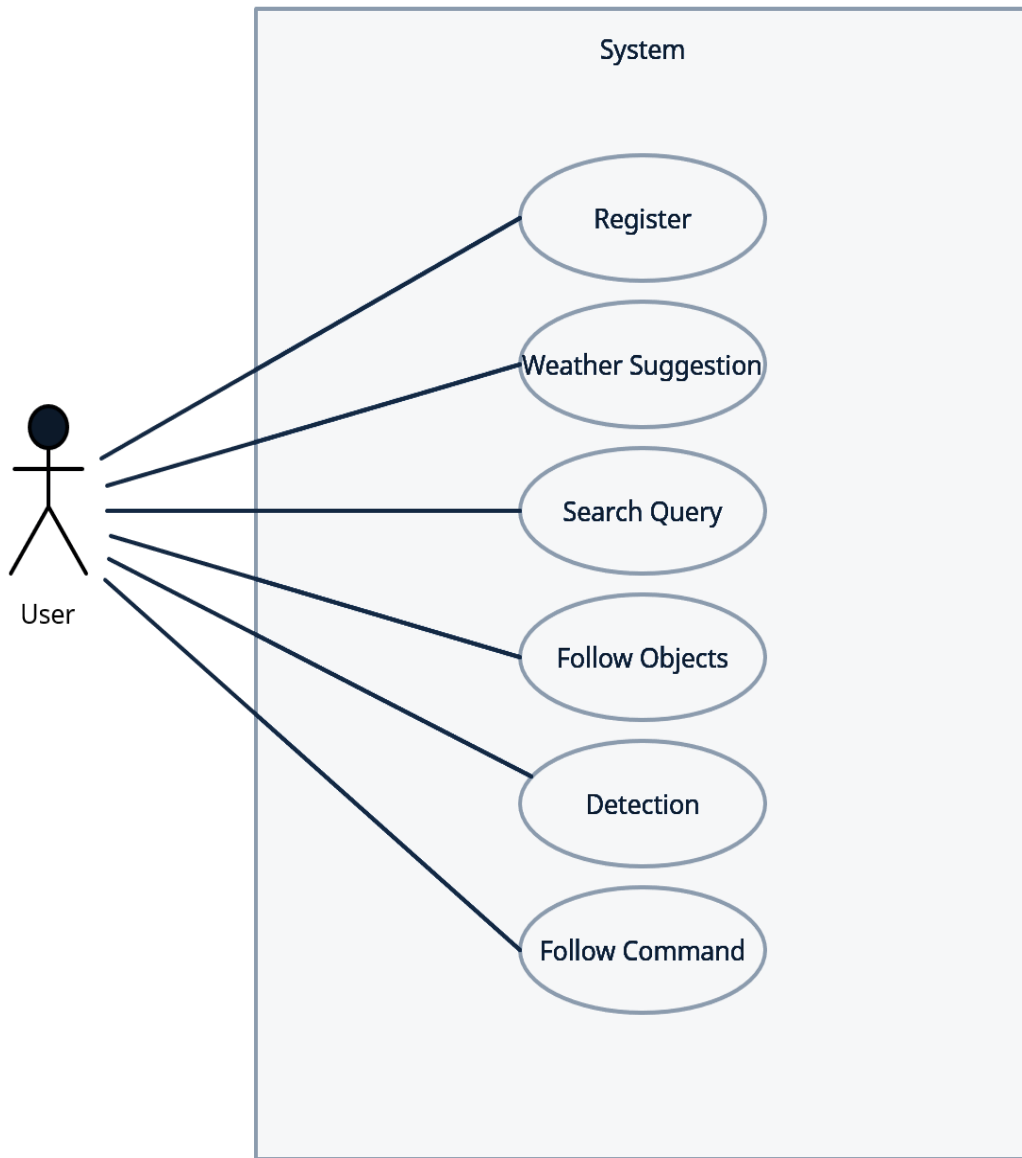


Figure 2: Use Case Diagram

### **3.4 Logical Data Model**

We need to have a lot of data for implementing a machine learning model. We collect data from external sources then train our model. In the production label our project also collects data and retrains our model and from that scope our model accuracy increases day by day. Our project also collects personal data to increase the accuracy of personal suggestions. On User table connected with image table and personal preference table in one too many relations where user-id used as a foreign key. Storing User information make our robot know the previous user and follow the current users command. One table for object detection data. For avoiding objects and detecting objects our personal machine learning model is used to increase efficiency. We have a list of command that is used for avoid by the robot of us. For control and maintain task our robot we have some command that is store in a table. From that table our robot access command and follow the rules of command. Taking data from user and validate the current user who controlling robot and only receive command from that user. Only registered user can give command to the robot. We also have weather and other misc. information of user for give preference.

### **3.5 Design Requirement**

From the survey of what basically people need and what can be added to our project we listed a functional requirement for our project. What features do we need to add and what kind of features can be added? All the requirements are listed as documents. Based on requirements we then implemented the feature. For giving a flexible working space and environment we collecting ideas and give those into reality. We listed out some requirements as like,

- (1) Notification from device
- (2) Alert from calendar
- (3) Face recognition
- (4) Object detection and avoiding
- (5) Surveillance
- (6) Auto charging
- (7) Personalize preference

Based on those requirements we then collect data and implement those features. The product elements we designed must so that we satisfy the requirements for the design of the subassemblies.

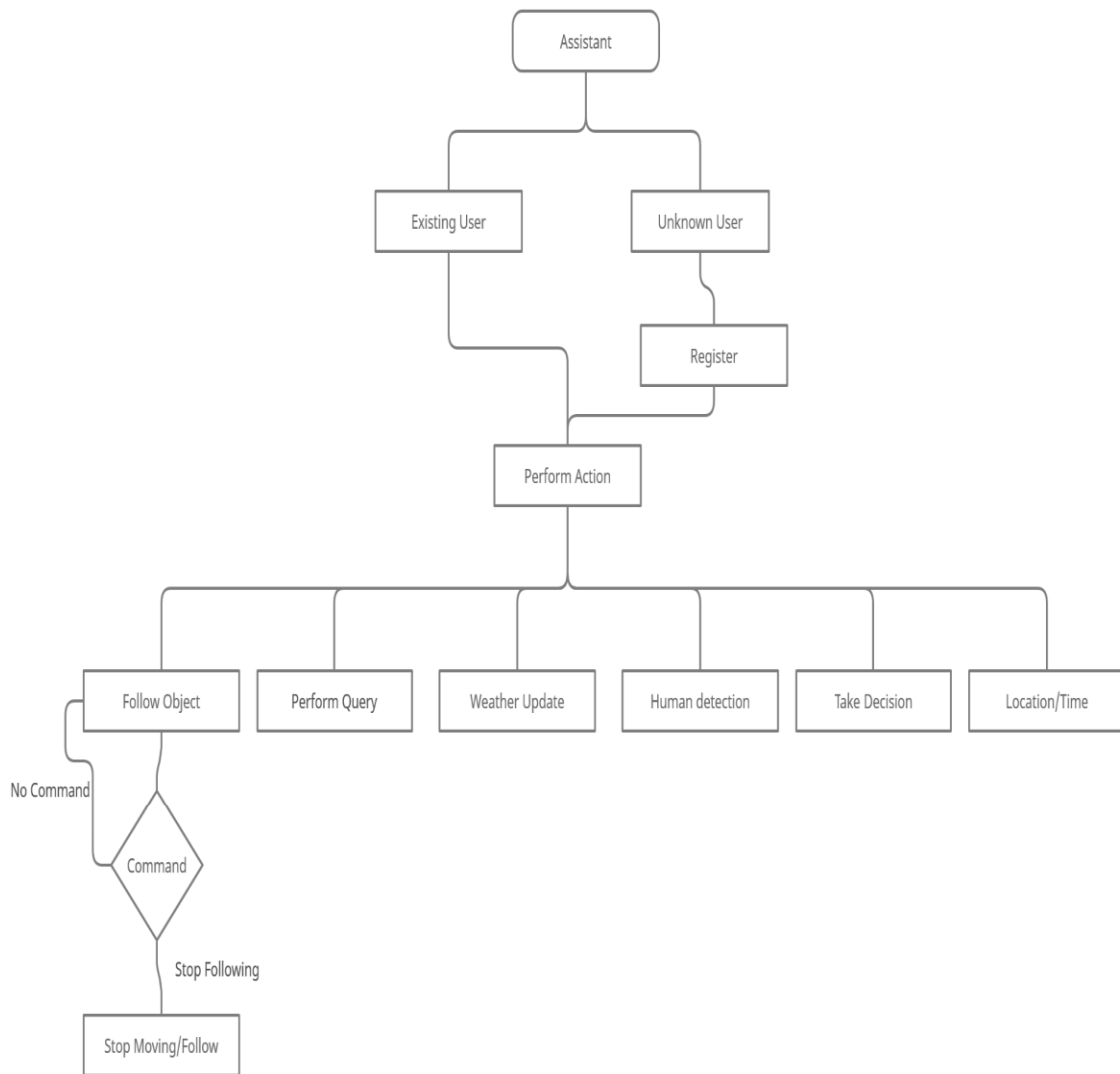


Figure 3: Flow Diagram

# Chapter 4

## Methodology

Creating an autonomous device or vehicle means it can move freely without any intervention of humans. Any object that can move by itself without any kind of predefined instructions or rules is not a very easy task. For moving freely it will need to observe the surroundings. For example it needs to find the objects which can be the obstacle. Autonomous devices must avoid the collision. So, the first duty to avoid collision is to see the object measure the distance and take necessary steps to prevent the collision. Our autonomous assistant also can detect humans by recognizing faces. It can determine the target person by recognizing the target person's face.

### 4.1 Detection

We used the Facenet algorithm to detect the target person. It is required to have an android device to use our smart autonomous assistant. We have an android application that works as our camera module and also as the data processing unit. With our android application, users can communicate with our smart assistant. Through a single picture a user can register himself with our smart assistant. It can store the data/image for further uses. Android devices can communicate with the Arduino board through a Bluetooth device. Camera of an android phone works as the eye of our assistant. Camera takes images and it gets processed in the android application which is developed using facenet algorithms to detect humans. We have an option to save face data in our system so that Users can store their information. Our assistant can recognize him/her by using previously stored images. In our robot there is a space for keeping our mobile device. So that our robot can use our mobile as a camera device and speaking device. Camera takes images then the android application processes the data. Data passes into the Arduino board via the bluetooth(HC-05) module. Arduino is responsible for moving the autonomous assistant. Android devices provide extra benefits. It can take voice commands. We used some google APIs to get the live weather updates.

The Android phone's camera takes an image then our software analyzes it and finds the target. It can locate where our target is, then it provides instructions to the Arduino.

## 4.2 Deep Learning

Deep learning is a popular way to work with object detection and recognition. It behaves like the human brain and works with layer by layer. It is a hierarchical feature learning. In this method, the image is converted pixel by pixel. It is learned by taking the image hierarchically and from recognizing the image sequentially layer by layer.

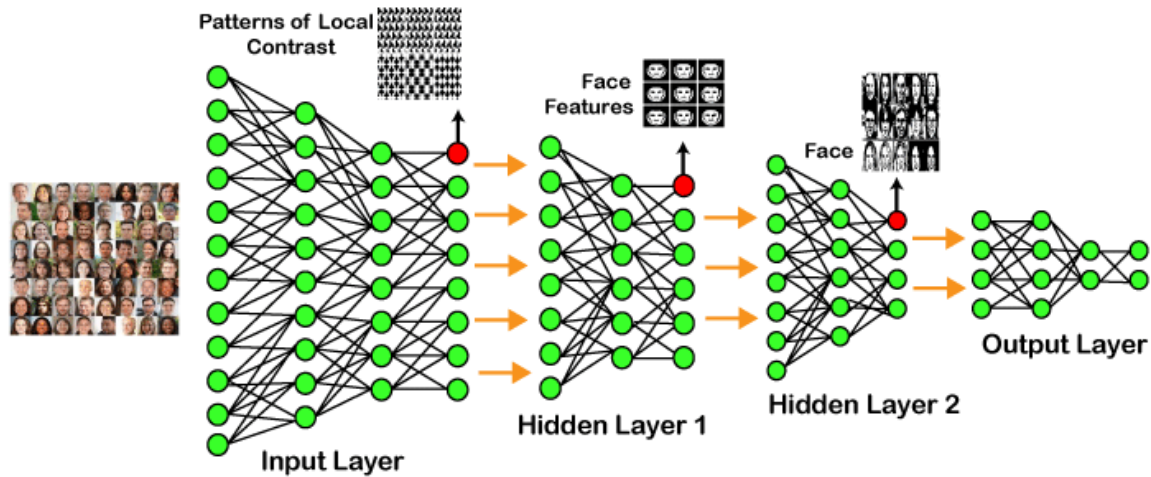


Figure 4: Deep Learning Layer

## 4.3 Convolutional Neural Network

Convolutional Neural Network is the part of Deep learning. In that part, the model learns the feature of the image part by part. Before taking the image into the deep learning model, CNN converts the image into small features.

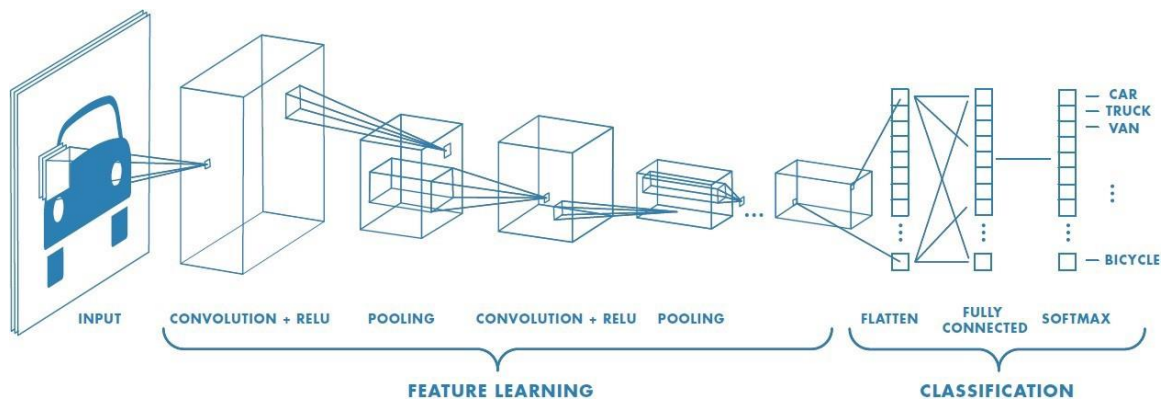


Figure 5: Convolutional Neural Network learning process

#### 4.4 Facenet Algorithm

Facenet algorithm is developed by Google. They use deep learning to develop this algorithm. It developed based on deep convolution neural network. This network consists of a batch input layer and a deep Convolutional neural network. It also followed by a L2 normalization. This model accept image as 160x160 pixels size.

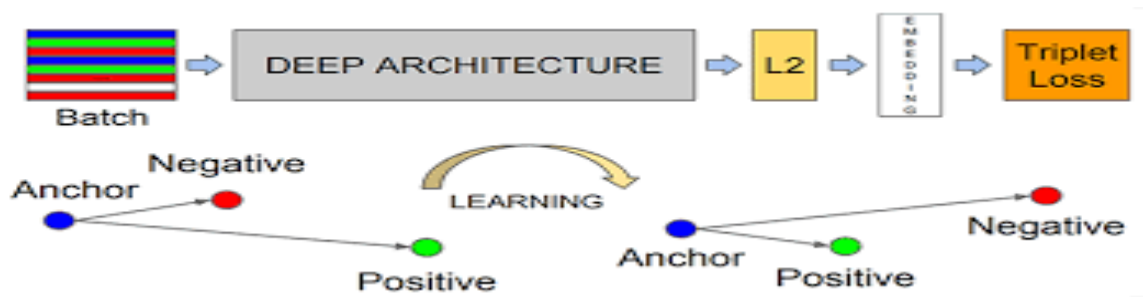


Figure 6: Facenet Algorithm

#### 4.5 YOLO V4:

YOLO (You only looks once) algorithm is implemented based on CNN to detect object. It works based on three techniques,

- Residuals Block
- Bounding Box
- Intersection Over Union

With residuals block it segment the image with a lot of block. Bounding box highlight a feature of an image. IOU handle the overlap bounding box of image segment or feature.

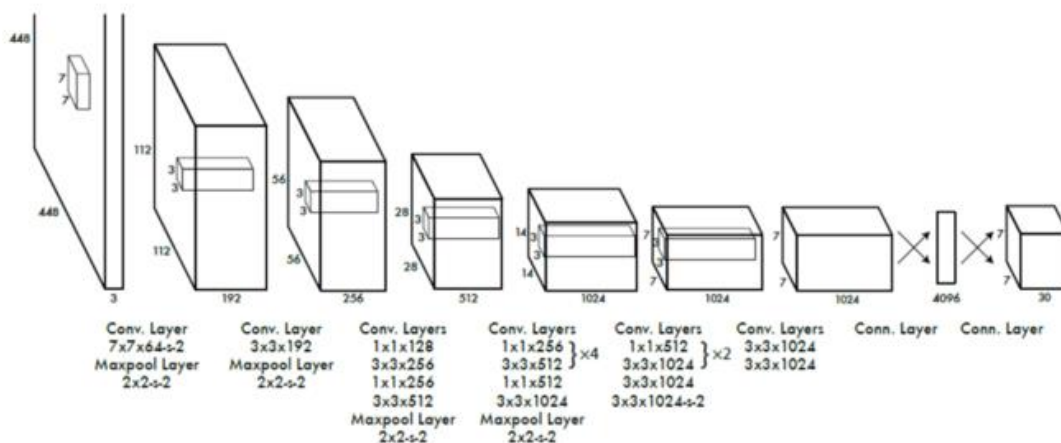


Figure 7: YOLO layers

## 4.6 Object Detection

To detect objects we used the YOLO v4 algorithm. It is faster than any other object detection algorithm. The YOLO algorithm takes only one forward propagation to detect the object. We implement human detections in android devices for the object detection part we used computer devices. This process is completed with the python programming language. By taking image data from the camera our model analyzes those data and takes the decision from those images. Our system can detect more than 80 objects. Such as chairs, table, bottle, bag, mouse, laptop, mobile phone etc. Predefined models can detect the object and provide the (X, Y) coordinate of the object. We used that coordination and program in a manner that every time it detects objects. Our smart assistant will move forward until the distance between object and robot is 70 cm. When the distance is less than 70 cm then our robot will turn left or right depending on the free space. As already mentioned, to determine the free space in the left or right we used (X, Y) coordination. To find the distance we used the lens formula. To use this formula we need to know the focal length of the camera and the object distance. So, we designed our model with some predefined objects and images with some data. For example. We provide a bottle's image with some known distance and width. After that it can take an image and compare the known image. Then it finds the distance in real time. Results from the image are sent to the microcontroller by the bluetooth module. The microcontroller takes the decision from the result obtained from the model. Our robot can move 360 degrees. 4 wheels are used in our robot and it is operated by the microcontroller. One servo motor is used for rotating the camera/mobile. Camera rotates based on the movement of the target object. Servo motor directly connected to the bluetooth device and microcontroller. We divided our code into various parts and implemented those parts by part. We make functions for detecting objects and one for the following objects. We are creating functionality for giving alerts and notifications from API and also giving personal preference. For creating an artificial intelligence model we use the You Only Look Once(YOLO) algorithm and Tensor Flow. We have a feature for getting continuous data from users and storing them and using those models to build our model and increase accuracy

# Chapter 5

## Design Specification

### 5.1 Front-End Design

In our project our hardware is our front end. We use a microcontroller camera and videos in source for our project. we will use a Raspberry Pi for our project. As we use artificial intelligence in our project that's why we need a good microcontroller our camera integrated with the microcontroller takes data from the environment and sends it to the AI model. Some sensors work for getting basic information from the environment, take decision from the environment. We have a four wheel vehicle structure that consists of four DC motors and a motor driver shield for controlling the motor. Our Raspberry pi is pre-programmed with knows how to control over data. We try to make the vehicle shape and size in a comfortable size and good looking.

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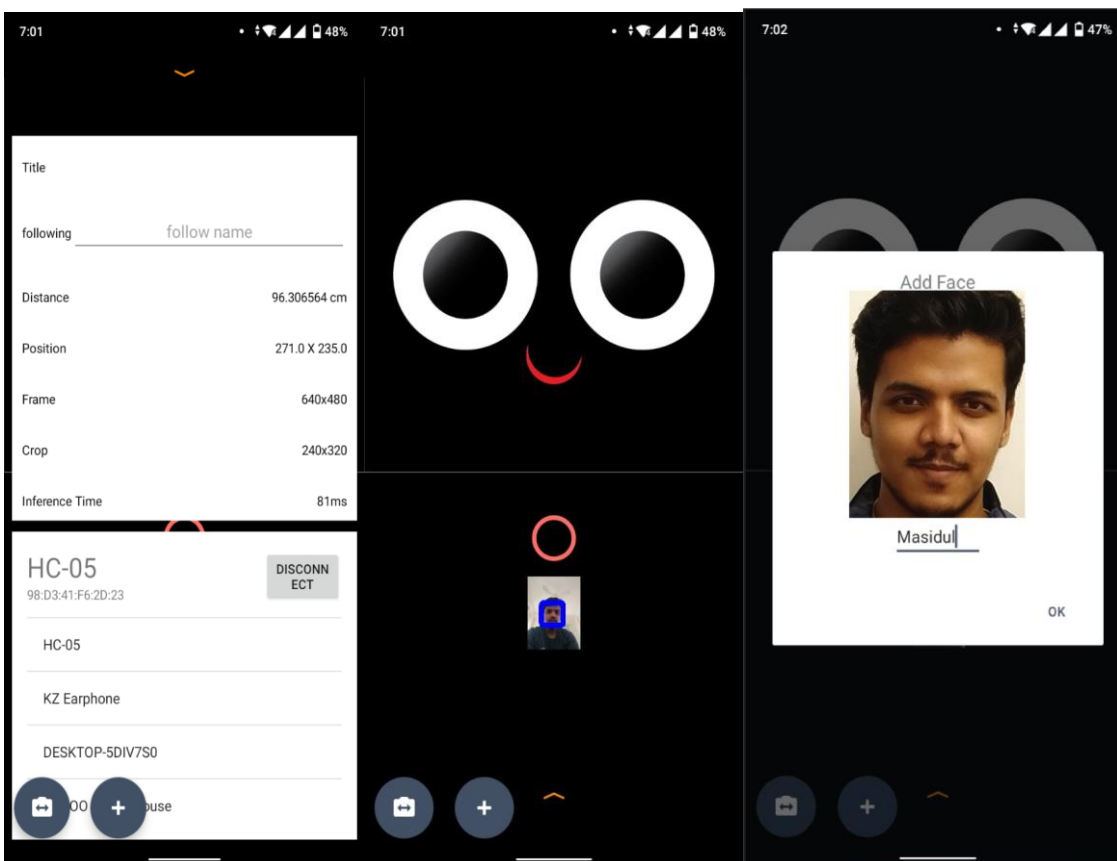


Figure 8: UI/UX design of Android App



## 5.2 Back-End Design

We implement our back end development with Python programming language. We create an artificial intelligence model And integrate this model into our microcontroller code. We divided our code into various parts and implemented those part by part. We make functions for deleting objects and one for the following objects fully stocked we are creating functionality for giving alerts and notification from API and also giving personal preference. For creating an artificial intelligence model we use the You Only Look Once(YOLO) algorithm and Tensorflow. We have a feature for getting continuous data from users and string them and using those models to build our model and increase accuracy. Every elements of our robot are chosen as a way that it can take less energy and can give 100% performance. Our goal is to make it simple as much as possible. For that reason our robot is accessible for every range of people. We choose Arduino Mega so that it can comfortable with every kind of robotic accessories. For moving our robot body we use 4 vehicle. Our robot can move and rotate in 360 degree angle. So for that reason we use a healthy motor driver and gear motor. For connecting with our android application we use a Bluetooth so that it can interact and share data among themselves. An android device is used for getting transformed image data to our robot. We have a dedicated software and it have ability to analyze those picture. After analyze it sends the output to the microcontroller. Based on the output out microcontroller take action and control the vehicle.

Instrument and Actuator we use so far,

Name	Price	Description	Consumption
Arduino Mega	\$20-\$25	Microcontroller	7-12V, 40mA
Gear Motor	\$1-\$10	Speed: 60-400rpm length: 14mm	9V, 0.05-0.2A
Motor Driver	\$1-\$10	H-bridge motor driver to control motor.	5-35V, 0.01-5A
Bluetooth Module	\$5-\$20	It can establish bluetooth connection with	3.3V, 50mA

		2.4GHz bandwidth	
Servo Motor	\$5-\$20	Rotational Range:180° Pulse Width:400-2400 $\mu$ s Pulse Cycle:20 ms	4.4-6.0V,
Battery	\$10		2200mAh, 11.11V

Table 2: Robotics equipment

### 5.3 Interaction Design and UX

Our interaction design is depending on Android Application. With our user friendly android application on can easily interact with our robot. Our robot/home assistant need to identify user by detecting there face. So first we have a section for detect face and register user if not exist in the database. Our android application has a smart and good interaction page for guide robot. Our smart eye can detect move its eye by detecting user movement. We also have a developer page for admin where admin/developer can adjust the variable which need to run our robot error friendly. This smart eye are the indicator of if the registered user are fully visual able to the robot. If user cant seen by the robot/camera then smart eye remain close. Also it have a admin panel where user can set the parameter by their own wish. They customize everything so that they can feel comfortable with the smart assistant. For register user we have both interface for take picture and input your name. Then analyzing those picture and your smart assistant will recognize you.

# Chapter 6

## Implementation and Testing

### 6.1 Implementation of Database

For this project we used a database for the question-answer portion and identify portion. Our robot will store the questions from the user and will ask several people the same questions. If the same answer is listened to by several people then it stores the answer as final. For identification it will store an image of a person by unique id and it will use the same id for other data related to that person's image. After detecting the person's image it will search more data related to that id then show the details. We also have a table for store command and output for the command. Our device recognize the command and based on the command it search on table. We have maintain a very simple database that can use only for command and user. Other things are mainly search from internet and show it to the user.

### 6.2 Implementation of Robot Body

In this part we used Arduino Mega, battery, hc-05 bluetooth module, switch, servo motor, motor driver, gear motors, wheels, wears, and pvc board. Finally we made the design below. We uploaded our code to arduino mega. It takes data from mobile and based on that data it can move.

This is the final design of the robot body. We used a PVC board for the base. We made such a design so that, it can move the mobile phone 360 \* 90 degrees. Our robot can move in 360 degrees so that it can follow the user every direction. For follow user up down we use a servo motor for rotating the camera or android device. So that it get the every angle the user move. For movement we user r gear motor and a motor driver shield. For connecting with the android device we use Bluetooth module.

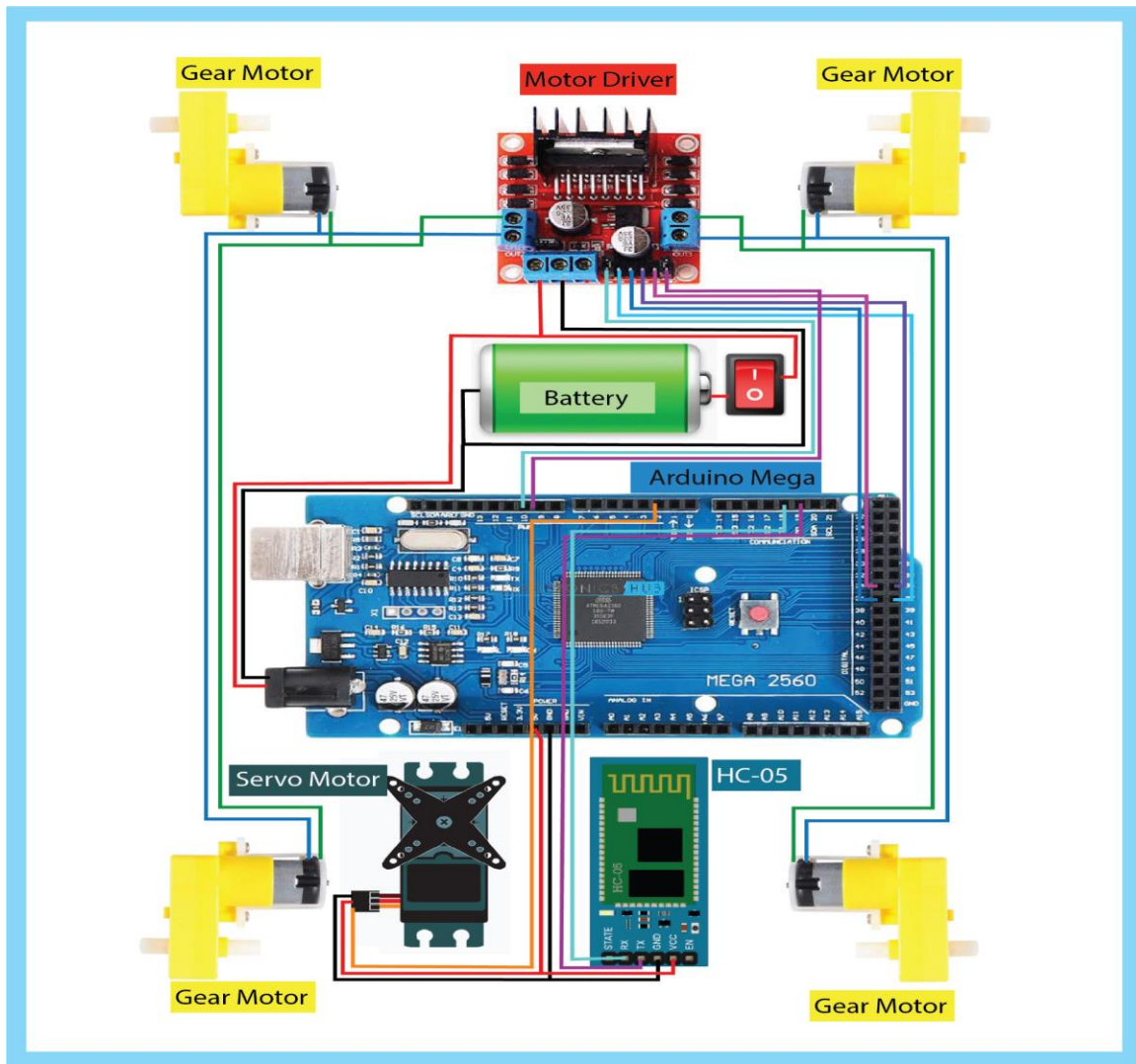


Figure 9: Circuit Diagram

### 6.3 Implementation of Final Robot

In the robot body there is a box for installing a mobile phone at the middle position of the body. Finally it looks like this. And first we have to turn on the body then connect our app with the body through bluetooth. After that we have to install it into the mobile case. Then, press the middle button of the mobile screen. That's it, now it is ready to serve you. For more information:

**Images:** <https://drive.google.com/drive/folders/1p-5TKJ5dt0PPZ0wKXB5bswGO-i0BJFdI?usp=sharing>

**Videos:** <https://drive.google.com/drive/folders/16KpfxAdqIrseRSnArkF6QAwqEGJDVLQ?usp=sharing>

## 6.4 Testing

We test our robots' lives. It can give weather updates. It can say whether we should go outside or not, is it safe to go to work today. It can detect humans and call them by their own name. It can follow a specific person if that command is given. If there is a person who is unknown to the robot then it asks for the identity for that person. If the person gives his identity then our robot remembers it. It also can tell how many people are in front of our robot and our robot also can say how many people it knows. It can tell us about our location. It follows our commands like come here, go back, follow me, what time is it, etc. It can answer like a google assistant. There are more things that it can do. We have a future plan to detect objects and avoid them. We test our project with respect to real-life situations. It performs well in those scopes. The success rate of our robot is 96%. Our robot can successfully detect places and can give weather updates successfully. It can recognize voice comments efficiently. By recognizing voice comments our robot can take necessary actions.

Commands	Expected Result	Actual Result	Execution Time (ms)	Accuracy
<i>come here</i>	The robot will come 20 cm closer to the user.	The robot comes 18 cm closer to the user.	2000	90% - Tested 50 times
<i>go back</i>	The robot will increase 20cm distance from the user.	The robot increases 19cm distance from the user.	2000	95% - Tested 50 times
<i>tell me the time</i>	The robot will tell exam time of its location.	The robot tells the exact time of its location.	1000	100% - Tested 100 times
<i>tell me the date</i>	The robot will tell the exact date of its location	The robot tells the exact date of its location	100	100% - Tested 100 times
<i>is it safe to go outside today</i>	The robot will tell can user whether to go outside or not based on weather.	The robot tells can user whether to go outside or not based on the weather.	800	95% - Tested 50 times

<i>tell how many persons are in front of you.</i>	The robot will tell the number of persons in front of it.	robot tells the number of persons in front of it.	900	90% - Tested 50 times
<i>do you know who am I</i>	The robot will tell the user name if he is registered. else it will ask about the user and register him/her automatically.	The robot tells the user's name if he is registered. else it asks about the user and registers him/her automatically.	8000	97% - Tested 50 times
<i>don't move</i>	The robot will stop moving	The robot stops its moving.	500	100% - Tested 100 times
<i>start moving</i>	The robot will start moving	The robot starts moving	500	100% - Tested 100 times
<i>don't talk</i>	The robot will stop talking	The robot stops talking	500	100% - Tested 50 times
<i>start talking</i>	The robot will start talking	The robot starts talking	500	100% - Tested 50 times
<i>follow 'name'</i>	The robot will follow the person if he/she is registered	The robot follows the person if he/she has registered	700	78% - Tested 50 times
<i>tell me our location</i>	The robot will tell the location where the robot is.	The robot tells the location where the robot is.	500	90% - Tested 50 times
<i>tell me the weather details</i>	The robot will tell the weather information.	The robot tells the weather information.	500	100% - Tested 100 times
<i>take a picture</i>	The robot will take a snapshot of the user.	The robot takes a snapshot of the user.	1400	100% - Tested 100 times

Table 3: Accuracy and commands of our robot

# Chapter 7

## Impact on Society, Environment and Sustainability

### 7.1 Impact on Society

Every type of resource and resource based works must have an impact on society. Either this impact is going to favor society or not. But the outcome of research or project work should be good for society. To mark a positive impact on society we can improve the individual's life. By improving every individual life from society we can easily improve the whole society. As we already know, this is an era of modern robotics. Nowadays robots are used to make life easier and risk free

By keeping those things in our minds we worked on this project and make life easy. Our autonomous home assistant will make life simple and insurable. our autonomous home assistant will work 24/7 with 100% efficiency. We can communicate in our assistant by voice comment we can comment it to follow a person basically the owner of the assistant. After that, we can ask our assistant to bring various kinds of objects. It will also work as a friend when indeed we can talk to our assistant, it can give data and provide feedback when we need it. Our assistant can recognize objects which we need to bring.

It is clear that an autonomous home assistant will change a person's daily lifestyle. It will improve the way a human spends his life now. So, when every individual life is changed and improved then ultimately the society will be improved. Because society is a combination of individuals.

Our automobiles home health system has a positive impact on the society appeal it can improve every single home offers society. It will save time, it can work autonomously so it doesn't require any humans interactions. So by saving time and keeping humans away from simple task autonomous assistance will have a huge impact on society. Now humans can enjoy their time to solve others problems or they can live their time the way they wanted to.

### 7.2 Impact on Environment

Basically our autonomous home assistant doesn't have any kind of Impact on the environment. But the purpose of our home assistant is to improve human daily lifestyle.

On the other hand we are using a fusible battery that's why it doesn't provide any waste. So, our assistant doesn't have any bad impact on the environment also we are thinking about solar power for future development scope.

### **7.3 Ethical Aspect**

in the modern golden age of technology we all are trying to make our life easier and more efficient. We are spending a lot of time on research and innovation. But we need to be concerned about the threat Or bad impact of her work. As a responsible citizen we already have concerns about the threats or bad impacts of our work. As responsible citizens we already have concerned about humanity and society. So we thought about the importance of time. We are developing day by day by doing lots of tasks. We are spending time on research and innovation. So, we thought that if we can make any autonomous assistant which can assist autonomously then we can save a lot of times those times can be used for them other important aspects. Our plan is to make a fully autonomous assistance which can assist us to complete our daily task and save valuable time.

### **7.4 Sustainability Plan**

How are autonomous assistant can move autonomously like a car so, our future plan is to use this concept and implement an autonomous car. We are developing our assistant day by day. We are trying to recognize more objects. We make sure that our robot are not any cause for environment disaster. We basically work for make human life more easier and from our smart assistant there is no chance of creating and dust that is harmful for the environment. How much we make human life easier human will more focus on making environment beautiful. With the limited resource we and make sure that our robot consume less energy we make a sustainable robot for using everyone's home.



# Chapter 8

## Conclusion and Future Scope

### 8.1 Discussion and Conclusion

This is the era of fourth industry revelation and AI is tremendously dominating this era. From this concept we are making this robot with the help of AI. In every aspect of our life we are taking the help of AI. From mobile devices to newspapers there is a place for Artificial Intelligence. It makes our life easier, comfortable and economical. For taking suggestions we search in google and it returns us the results by using artificial intelligence. Here we just make it easier for us that we don't need to search every time in google but our robot or smart assistant automatically searches you by your voice command or by your need that surely reduces time, reduces your hassle. A term comes every time how efficient this robot is in our daily life? This is a human helper. It can tell when you have a meeting and also can tell if you are getting late for the meeting. So it is obviously a personal assistant in your daily life. Not only that it is also affordable for middle-class families. As we are mostly dependent on software , we reduce the use of sensors and other hardware. So in that case we reduce a lot of production costs that definitely reduce the cost of our robot.

### 8.2 Scope for Future Development

We have already discussed that we are going to create an autonomous car that can move within a lane automatically by avoiding objects. Also it goes to the destination automatically and can carry goods or passengers. It will be a great success for us when we implement it. That vehicle can be used on university campuses or bin industry promises. It saves time for authority as well as encourages employees/students to do their duty properly. Also we have a lot of ideas to implement in our smart assistant in the future. Our target is to make it reasonable for everyone as much as possible. We have an idea to implement scene understanding based on computer vision. From the video, our assistant will predict the scene and can give feedback about the scene to the concerned.

Basically it is an ongoing process. From the need of people or the need of the situation we will implement a lot of features to our smart assistant. As our project is basically based on software if any update occurs there is no need to change in hardware.

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