NAIN 1.0 – A HUMANOID ROBOT

by

Shivam Shukla	**(1406831124)**
Shubham Kumar	**(1406831131)**
Shashank Bhardwaj	**(1406831117)**

GROUP OF INSTITUTIONS

Department of Electronics & Communication Engineering
Meerut Institute of Engineering & Technology
Meerut, U.P. (India)-250005

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Shivam Shukla (1406831124)

Shubham Kumar (1406831131)

Shashank Bhardwaj (1406831117)

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Dr. A.P.J. Abdul Kalam Technical University, Lucknow
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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning except where due acknowledgment has been made in the text.

Signature
Name: Mr. Shivam Shukla
Roll No. 1406831124
Date:

Signature
Name: Mr. Shashank Bhardwaj
Roll No. 1406831117
Date:

Signature
Name: Mr. Shubham Kumar
Roll No. 1406831131
Date:

CERTIFICATE

This is to certify that Project Report entitled **"Humanoid Robot"** which is submitted by **Shivam Shukla (1406831124), Shashank Bhardwaj (1406831117), Shubahm Kumar (1406831131)** in partial fulfillment of the requirement for the award of degree B.Tech in **Department of Electronics & Communication Engineering** of Gautam Buddh Technical University (Formerly U.P. Technical University), is record of the candidate own work carried out by him under my/our supervision. The matter embodied in this thesis is original and has not been submitted for the award of any other degree.

Date:

Ms. Mohini Preetam Singh
Astt. Prof

ACKNOWLEDGMENT

It gives us a great sense of pleasure to present the report of the B.Tech Project undertaken during B.Tech Final Year. We owe special debt of gratitude to **Ms. Mohini Preetam Singh, Astt. Prof.** in the Department of Electronics & Communication Engineering, Meerut Institute of Engineering & Technology, Meerut for his constant support & guidance throughout the course of our work. His sincerity, thoroughness and perseverance have been a constant source of inspiration for us. It is only his cognizant efforts that our endeavors have seen light of the day.

We also take the opportunity to acknowledge the contribution of all the members of **CPLD LAB** for their full support and assistance during the development of our project.

We also do not like to miss the opportunity to acknowledge the contribution of all faculty members of the department for their kind assistance and cooperation during the development of our project. Last but not the least, we acknowledge our friends for their contribution in the completion of the project

Signature
Name: Mr. Shivam Shukla
Roll No. 1406831124
Date:

Signature
Name: Mr. Shashank Bhardwaj
Roll No. 1406831117
Date:

Signature
Name: Mr. Shubham Kumar
Roll No. 1406831131
Date:

ABSTRACT

Most of the world's leading robotics manufacturing companies are already bidding in the process to make the best suitable humanoid which will reduce the work load of a normal human being and will assist in personal and industrial life.

To make this target achievable, we are proposing NAIN 1.0 – the basic version of what will be known as the cheap and reliable humanoid robot that can be used to teach this technology to students across the country.

Nain 1.0 will have basically 5 detachable modules- 1) Arm – which can be controlled via servos. 2) Wheels – which can be controlled with dc motors. 3) Leg – Nain will be able to switch between wheels or legs for movement. 4) Head – Its head can be controlled for various nods. 5) Camera module- which can be interfaced for Face Recognition Access.

Along with this NAIN will be able to speak and interact with users and can show you the time by its inbuilt clock. It will have a wireless control using Wi-fi /Bluetooth*.*

The implementation of this project will help in learning concept of humanoid robotics in the students across the country which will support the government's mission using Atal Tinkering Labs. NAIN 1.0 will later be advanced from wheel based to biped system and will use AI in its perspective. It will be manufactured locally to reduce the cost and support Make in India initiative.

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CHAPTER 1

INTRODUCTION

A robot is a machine—especially one programmable by a computer— capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed to take on human form but most robots are machines designed to perform a task with no regard to how they look. Robots can be autonomous or semi-autonomous and range from humanoids such as Honda's *Advanced Step in Innovative Mobility* (ASIMO) and TOSY's *TOSY Ping Pong Playing Robot* (TOPIO) to industrial robots, medical operating robots, patient assist robots, dog therapy robots, collectively programmed *swarm* robots, UAV drones such as General Atomics MQ-1 Predator, and even microscopic nano robots**.**

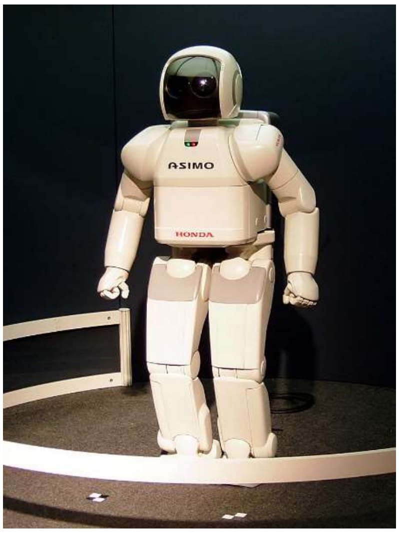

Fig. 1.1 ASIMO at the Expo 2005

The branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing is robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behaviour, or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics.

1.1 OBJECTIVES OF ROBOTICS

1.1.1 Degrees of freedom (mechanics)

In mechanics, the degree of freedom (DOF) of a mechanical system is the number of independent parameters that define its configuration. It is the number of parameters that determine the state of a physical system and is important to the analysis of systems of bodies in mechanical engineering, aeronautical engineering, robotics, and structural engineering.

1.1.2 Work volume of Robot

A space on which a robot can move and operate its wrist end is called as a work volume. The term "work volume" refers to the space within which the robot can operate. To be technically precise, the work volume is the spatial region within which the end of the robot's wrist can be manipulated. Robot manufacturers have adopted the policy of defining the work volume in terms of the wrist end, with no hand or tool attached.

1.1.3 End effector

It is a device or tool that's connected to the end of a robot arm where the hand would be. The end effector is the part of the robot that interacts with the environment. The structure of an end effector and the nature of the programming and hardware that drives it depend on the task the robot will be performing.

1.1.4 Term work envelope

It is the shape created when a manipulator reaches forward, backward, up and down. These distances are determined by the length of a robot's arm and the design of its axes. Each axis contributes its own range of motion. Still, many of the robots are designed with considerable flexibility. Some have the ability to reach behind themselves.

1.2 NEED OF ROBOTS

1.2.1 Military Services:

Military robots are some of the most high-tech and important robots used today. These state-of-the-art machines save lives by performing extremely dangerous tasks without endangering humans. Some common robots used by the military are Explosive Ordinance Disposal (EOD) robots, which are capable of examining suspicious packages and surrounding areas to find and even deactivate improvised explosive devices (IEDs) and mines. They can even deliver unexploded ordinance for examination and proper detonation. The military also uses unmanned aerial vehicles for reconnaissance missions, to scope out enemy movements, find hidden explosives and give the Air Force a wide-angle surveillance of their battlespace.

1.2.2 Car Production:

Robots are used in the automobile industry to assist in building cars. These high-powered machines have mechanical arms with tools, wheels and sensors that make them ideal for assembly line jobs. Not only do robots save more money in manufacturing costs, but they also perform tough tasks at a pace no human could possibly do. Robots also make car manufacturing safer because they can take on dangerous and difficult jobs in place of humans. Automotive industry robots are capable of performing a wide range of tasks such as installation, painting and welding, and aren't restricted by fatigue or health risks, therefore making them an incredibly useful and irreplaceable part of car production.

1.2.3 Space Exploration:

One of the most amazing areas of robotics is the use of robots in space. These state-of-the-art machines give astronauts the chance to explore space in the most mind-boggling ways. The most commonly used space robots are the Remotely Operated Vehicle (ROV) and the Remote Manipulator System (RMS), which are both used in a variety of space missions. ROVs can be unmanned spacecraft that orbit freely or land when it makes contact with an outer space surface and explore the terrain. Both capture remarkable data and visual footage that would never be humanly possible without the assistance of robots. RMS mechanical arms also help astronauts perform very important and difficult tasks during space missions.

1.2.4 Remote and Minimally-Invasive Surgery:

Robot-assisted surgery has truly changed the face of medicine by expanding surgeons' capabilities in ways no human could. Surgical robots are directed by human surgeons who use a computer console to move instruments attached to robot arms. The surgeon's movements are translated by a computer and then performed on the patient by the robot. Today's surgical robots are so advanced that it's possible for surgeons to perform remote surgery without physically being in the operating room or even in the same country! Robot-assisted surgery has improved the limitations of minimally invasive surgery and has many advantages over traditional open surgery, including greater precision, smaller incisions, less pain and decreased blood loss. Surgical robots, such as the da Vinci Surgical System, are used for gynecologic, colorectal, prostate, throat cancer surgeries, as well as bariatric surgery, angioplasty and bypass surgery.

1.2.5 Underwater Exploration:

Underwater robots have radically changed the way we see the world from the ocean floor. Underwater robots can dive longer and deeper than any human, and they provide an up-close look at marine life. These amazing machines are equipped with sensors, high-definition cameras, wheels and other technology to assist scientists when they explore docks, ocean floors, dams, ship bellies and other surfaces. The most common underwater robots used today are the remote-operated vehicles (ROVs) that are controlled by humans sitting in the command center. ROVs are connected by cable to ships and are the best tool for gathering data and images of life under water.

1.2.6 Duct Cleaning:

Duct cleaning is done best by a robot that can actually fit into these hazardous and tight spaces. Robots provide a more effective and efficient cleaning than manual brushes. It's also safer for industrial and institutional markets to use robots because workers are not exposed to harmful chemicals or enzymes that come from dust mites. Duct cleaning robots are used in hospitals and government buildings that may have hazardous or contaminated environments, as well as embassies and prisons for a shorter and more secure cleaning. Using duct cleaning robots translates to quicker, safer, cheaper and more effective duct cleanings without the need of a human.

1.2.7 Fight Crime:

Police robots help fight crime without risking the lives of police officers. Law enforcement officers use an array of high-tech and remote-controlled robots that are equipped with front and back cameras, infrared lighting and a speaker to search for criminals and find their location without endangering a police officer. State-of-the-art tools like the Robotex robot is waterproof, can climb stairs and flip itself over and has a 360-degree camera to help catch criminals. Other equipment, such as the Andros F6-A, are used by police agencies during hostage situations. This heavy-duty robot is capable of shooting off a water cannon or weapon in order to detain a criminal and protect those who are in danger.

1.2.8 Fix Oil Spills:

As we saw in the 2010 BP oil spill, robots play a critical role in fixing oil spills. Underwater robots are used to explore the well site and interact with the problematic equipment. Engineers use remote-operated vehicles (ROVs) that dive to great depths and stay submerged for much longer than any human ever could. ROVs are remote-controlled submarines that are operated by humans sitting in the command center. These high-tech robots are connected by cable to ships and are used to collect video footage and information from fiber-optic sensors that help engineers better understand the problem and intervene when necessary. ROVs have hydraulic arms with interchangeable tools, such as saws and cutters, which are used for intervention tasks. Even after the well is capped, robots are used to patrol the well site and make sure oil is no longer escaping.

1.2.9 Investigating Hazardous Environments:

Robots have become increasingly important for investigating and researching hazardous and dangerous environments. These robots are capable of entering an active volcano to collect data or a burning building to search for victims. Robots such as the Scout Throwable Robot are used by law enforcement agencies and fire departments to help find information about people stuck inside a building, and even have the ability to detect grenades or explosives in the area. These unmanned robots also save lives because they prevent people from having to enter the hazardous environment before they knowing what to expect.

CHAPTER 2

LITRATURE REVIEW

2.1 HISTORY

The idea of automata originates in the mythologies of many cultures around the world. Engineers and inventors from ancient civilizations, including Ancient China, Ancient Greece, and Ptolemaic Egypt, attempted to build self-operating machines, some resembling animals and humans. Early descriptions of automata include the artificial doves of Archytas, the artificial birds of Mozi and Lu Ban, a "speaking" automaton by Hero of Alexandria, a washstand automaton by Philo of Byzantium, and a human automaton described in the *Lie Zi*.

In ancient Greece, the Greek engineer Ctesibius (c. 270 BC) "applied a knowledge of pneumatics and hydraulics to produce the first organ and water clocks with moving figures." In the 4th century BC, the Greek mathematician Archytas of Tarentum postulated a mechanical steam-operated bird he called "The Pigeon". Hero of Alexandria (10–70 AD), a Greek mathematician and inventor, created numerous user-configurable automated devices, and described machines powered by air pressure, steam and water.

Fig. 2.1 Model of Leonardo’s robot with inner workings

The term comes from a Czech word, *robota*, meaning "forced labor"; the word 'robot' was first used to denote a fictional humanoid in a 1920 play *R.U.R.* by the Czech writer, Karel Čapek but it was Karel's brother Josef Čapek who was the word's true inventor. Electronics evolved into the driving force of development with the advent of the first electronic autonomous robots created by William Grey Walter in Bristol, England in 1948, as well as Computer Numerical Control (CNC) machine tools in the late 1940s by John T. Parsons and Frank L. Stulen. The first commercial, digital and programmable robot was built by George Devol in 1954 and was named the Unimate. It was sold to General Motors in 1961 where it was used to lift pieces of hot metal from die casting machines at the Inland Fisher Guide Plant in the West Trenton section of Ewing Township, New Jersey.

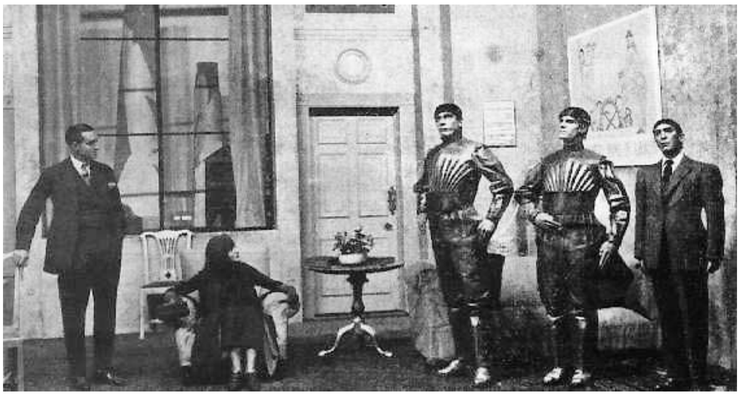

Fig. 2.2 A scene from Karel Čapek's play, showing 3 robots

2.2 MODERN ROBOTS

There was once a time when robots were limited to science-fiction movies and novels. The man-made beings that carried out tasks, which humans could not was something that people always dreamed to see in their lifetimes. With today's developments in technology and the field of robotics, we have a wide variety of droids, drones and robots, all available for our service.

2.2.1 Mobile Robot

Mobile robots have the capability to move around in their environment and are not fixed to one physical location. An example of a mobile robot that is in common use today is the *automated guided vehicle* or *automatic guided vehicle* (AGV). An AGV is a mobile robot that follows markers or wires in the floor, or uses vision or lasers. AGVs are discussed later in this article.

Mobile robots are also found in industry, military and security environments. They also appear as consumer products, for entertainment or to perform certain tasks like vacuum cleaning. Mobile robots are the focus of a great deal of current research and almost every major university has one or more labs that focus on mobile robot research.

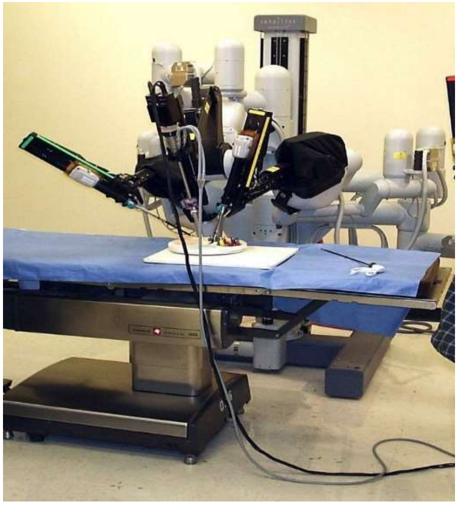

Fig. 2.3 A laparoscopic robotic surgery machine

2.2.2 Industrial Robots

Industrial robots usually consist of a jointed arm (multi-linked manipulator) and an end effector that is attached to a fixed surface. One of the most common type of end effector is a gripper assembly.

The International Organization for Standardization gives a definition of a manipulating industrial robot in ISO 8373:

"an automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications."

This definition is used by the International Federation of Robotics, the European Robotics Research Network (EURON) and many national standards committees.

Fig. 2.4 A pick and place robot in a factory

2.2.3 Educational Robot

Robots are used as educational assistants to teachers. From the 1980s, robots such as turtles were used in schools and programmed using the Logo language.

There are robot kits like Lego Mindstorms, BIOLOID, OLLO from ROBOTIS, or BotBrain Educational Robots can help children to learn about mathematics, physics, programming, and electronics. Robotics have also been introduced into the lives of elementary and high school students in the form of robot competitions with the company FIRST (For Inspiration and Recognition of Science and Technology). The organization is the foundation for the FIRST Robotics Competition, FIRST LEGO League, Junior FIRST LEGO League, and FIRST Tech Challenge competitions.

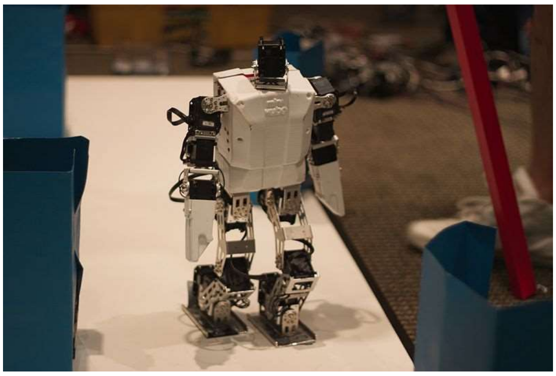

Fig. 2.5 Humanoid robot constructed using the Bioloid kit

CHAPTER 3
METHODOLOGY ADOPTED AND TOOLS USED

3.1 STRUCTURE

Mechanical structure of humanoid robot is an important task in the development of humanoid robot. Stiffness and compliance consist with humanoid decide the flexibility of structure. The main objective is to design humanoid structure that can easily manipulate and capable of handling the entire situation like human.
While designing we have to consider so many parameters. These parameters include design of link, types of joint, forces on each joint, degree of freedom of each link, mass and height of body and shape of brain. Since movements of all the links is controlled by the processor which is fixed in the brain. So brain of humanoid computes the controllable signal and sends it to different locations. Material selection is also an issue for fabrication of humanoid. Structure from metal makes the structure very heavy. In this work the base of humanoid will be prepared from stainless steel and outer structure will be prepared from fibers. The structure has high resistance and more stiffness. The basic process of designing is payload and atmospheric pressure which acts on the humanoid. Also we try to give the body rotation of 360 degrees, so that without delay the humanoid can move backward.

3.2 COMPONENTS

The following components are used in the prototype

3.2.1 Arduino

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (*shields*) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

Most Arduino boards consist of an Atmel 8-bit AVR microcontroller with varying amounts of flash memory, pins, and features. Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the Arduino UNO is the optiboot bootloader. Boards are loaded with program code via a serial connection to another computer.

Arduino Mega

The MEGA 2560 is designed for more complex projects. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities.

Fig. 3.1 Arduino Mega

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

Specification

Table 3.1: Specifications of Arduino Mega

Operating Voltage	5 V
Input Voltage (recommended)	7-12 V
Input Voltage (limit)	6-20 V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm
Weight	37

3.2.2 Bluetooth Module: HC-05

To setup Wireless Serial Communication, HC-05 Bluetooth Module is most demanding and popular due to its low price and extremely high features.

This module can be used in Master or Slave Mode and easy switchable between these two modes, by default Slave mode is configured. Modes can be changed using AT Commands.

The slave mode in HC-05 cannot initiate a connection to another Bluetooth device, but can accept connections. Master mode can initiate a connection to other devices.

Fig. 3.2 HC-05

Table 3.2: Specifications of HC-05

Bluetooth protocol	Bluetooth Specification v2.0+EDR
Frequency	2.4GHz ISM band
Modulation	GFSK(Gaussian Frequency Shift Keying)
Emission power	≤4dBm, Class 2
Sensitivity	≤-84dBm at 0.1% BER
Speed	Asynchronous: 2.1Mbps(Max) / 160 kbps, Synchronous: 1Mbps/1Mbps
Power supply	+3.3VDC 50mA
Working temperature	-20 ~ +75Centigrade
Dimension	26.9mm x 13mm x 2.2 mm

3.2.3 Raspberry PI

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries

A mainstay in the world of makers and electronics, The Raspberry Pi is a single-board, low-cost, high-performance computer first developed in the UK by the Raspberry Pi Foundation. Not only has it helped bring the joy of electronics and computer programming to people around the world, but it has also become a staple of the maker community. The ever-present Pi is now in its seventh iteration—Raspberry Pi 3 Model B+—as the Pi Foundation continues to improve on an already excellent product.

Raspberry Pi 3 Model B

The quad-core Raspberry Pi 3 is both faster and more capable than its predecessor, the Raspberry Pi 2. For those interested in benchmarks, the Pi 3's CPU--the board's main processor--has roughly 50-60 percent better performance in 32-bit mode than that of the Pi 2, and is 10x faster than the original single-core Raspberry Pi (based on a multi-threaded CPU benchmark in SysBench).

Unlike its predecessor, the new board is capable of playing 1080p MP4 video at 60 frames per second (with a bit rate of about 5400Kbps), boosting the Pi's media center credentials. That's not to say, however, that all video will playback this smoothly, with performance dependent on the source video, the player used and bitrate.

The Pi 3 also supports wireless internet out of the box, with built-in Wi-Fi and Bluetooth.

The latest board can also boot directly from a USB-attached hard drive or pen drive, as well as supporting booting from a network-attached file system, using PXE, which is useful for remotely updating a Pi and for sharing an operating system image between multiple machines.

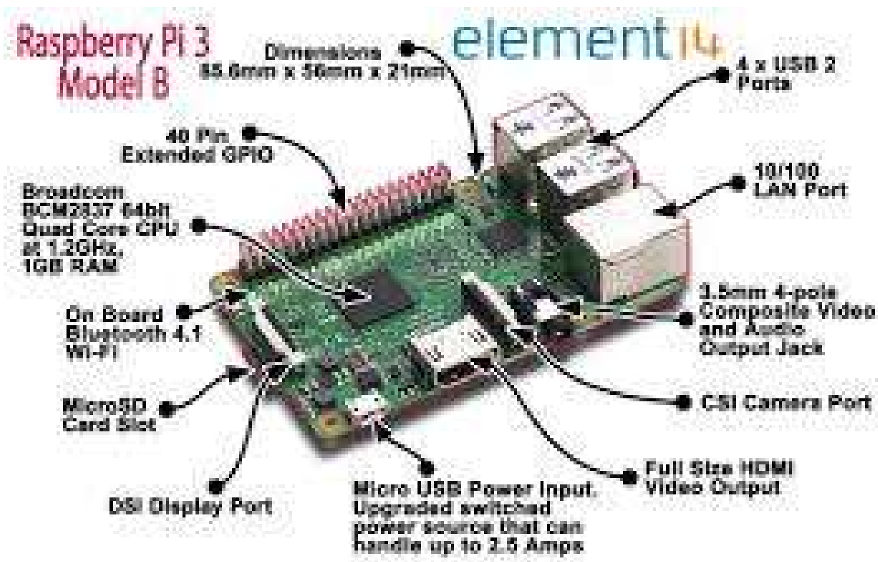

Fig. 3.3 Raspberry PI

Specifications

Table 3.3: Specifications of Raspberry PI model 3

	Raspberry Pi 3 Model B
Introduction Date	2/29/2016
SoC	BCM2837
CPU	Quad Cortex A53 @ 1.2GHz
Instruction set	ARMv8-A
GPU	400MHz VideoCore IV
RAM	1GB SDRAM
Storage	micro-SD
Ethernet	10/100
Wireless	802.11n / Bluetooth 4.0
Video Output	HDMI / Composite
Audio Output	HDMI / Headphone
GPIO	40
Price	$35

3.2.4 Servo Motor

It is tiny and lightweight with high output power. This servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos.It comes with a 3 horns (arms) and hardware.

Fig. 3.4 Servo motor

Specification

Table 3.4: Specifications of Servo motor

Operating Voltage	4.8 V to 7.2 V
Operating speed	0.2s/60 degree
Stall torque	8.5 to 10.5 kgf.cm
Dead band width	5 us
Temperature range	0 °C – 55 °C

3.2.5 USB Camera

USB Cameras are imaging cameras that use USB 2.0 or USB 3.0 technology to transfer image data. USB Cameras are designed to easily interface with dedicated computer systems by using the same USB technology that is found on most computers. The accessibility of USB technology in computer systems as well as the 480 Mb/s transfer rate of USB 2.0 makes USB Cameras ideal for many imaging applications. An increasing selection of USB 3.0 Cameras is also available with data transfer rates of up to 5 Gb/s.

Fig. 3.5 USB Camera

3.3 INTERFACING

3.3.1 DC Motor Interface

A DC motor is any of a class of rotary electrical machines 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 flow in part of the motor.

A direct current, or DC, motor is the most common type of motor. DC motors normally have just two leads, one positive and one negative. If you connect these two leads directly to a battery, the motor will rotate. If you switch the leads, the motor will rotate in the opposite direction.

To control the direction of the spin of DC motor, without changing the way that the leads are connected, you can use a circuit called an H-Bridge. An H bridge is an electronic circuit that can drive the motor in both directions. H-bridges are used in many different applications, one of the most common being to control motors in robots. It is called an H-bridge because it uses four transistors connected in such a way that the schematic diagram looks like an "H."

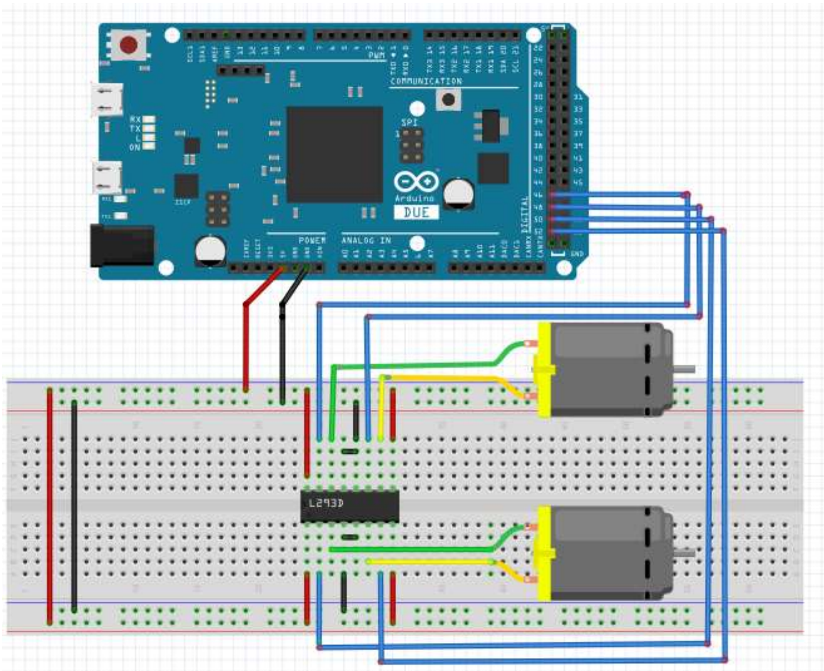

Fig. 3.6 Interfacing of DC motor with Arduino

3.3.2 Servo Motor Interface

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Servomotors are not a specific class of motor although the term *servomotor* is often used to refer to a motor suitable for use in a closed-loop control system.

Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

Because servo motors use feedback to determine the position of the shaft, you can control that position very precisely. As a result, servo motors are used to control the position of objects, rotate objects, move legs, arms or hands of robots, move sensors etc. with high precision. Servo motors are small in size, and because they have built-in circuitry to control their movement, they can be connected directly to an Arduino.

Most servo motors have the following three connections:

- Black/Brown ground wire.
- Red power wire (around 5V).
- Yellow or White PWM wire.

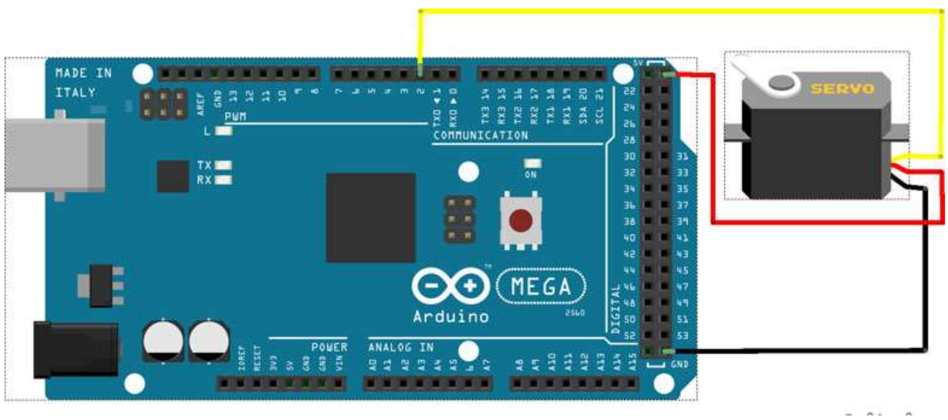

Fig. 3.7 Interfacing of servo motor with Arduino Mega

3.3.3 Image Processing

Digital image processing is the use of computer algorithms to perform image processing on digital images.

Digital image processing allows the use of much more complex algorithms, and hence, can offer both more sophisticated performance at simple tasks, and the implementation of methods which would be impossible by analog means.

In particular, digital image processing is the only practical technology for:

- Classification
- Feature extraction
- Multi-scale signal analysis
- Pattern recognition
- Projection

3.3.4 USB Camera Interface

To perform image processing on Raspberry Pi, a USB Camera is interfaced with its USB port.

Fig 3.8 Interfacing of camera with PI

3.3.5 Sound Processing

Audio signal processing or audio processing is the intentional alteration of audio signals often through an audio effect or effects unit. As audio signals may be electronically represented in either digital or analog format, signal processing may occur in either domain. Analog processors operate directly on the electrical signal, while digital processors operate mathematically on the digital representation of that signal.

A digital representation expresses the pressure wave-form as a sequence of symbols, usually binary numbers. This permits signal processing using digital circuits such as microprocessors and computers. Although such a conversion can be prone to loss, most modern audio systems use this approach as the techniques of digital signal processing are much more powerful and efficient than analog domain signal processing.

3.4 PROJECT DEVELOPMENT

The project development begins after the project idea has been conceived and required optimizations are already done. It is a step by step method of reaching the end/final project from the project idea.

- First the idea is thought and after its confirming its feasibility, research is done to check the history of the idea.
- Once proper information is gathered regarding the idea, we start converting the idea into a block diagram aka bird eye view of the project.
- Then we move into each block and make practical connections. This shows the connections and interfaces in the circuit. This is aka circuit diagram.
- The circuit diagram is then usually realised on breadboard to check it's working. We generally generate, what is called a prototype to simulate our circuit and make changes if required.
- This step is important as removal of errors and optimization is done majorly in this part.

3.4.1 Structure

The robot consists of a head, neck, shoulder, two arms and two legs which are mounted on movable chassis.

The structure is made of aluminium rods which provides rigidity without making it heavy and also lowers the cost.

Fig. 3.9 Structure of NAIN

At the end of shoulder both the arms are connected with servo motor giving them full rotation of hands like ball and socket joint in human body. A servo motor is also connected at the elbow of both the arms which provides motion for the shaking hands and waving of hands.

Right now the legs have no joints to move but are fixed over a movable chassis whose movements are controlled by the user.

The overall cost of the project is under **INR 10,000.**

3.4.2 Movement of Robot

3.4.2.1 Arms Movement

The mechanical design of the robot arm is based on a robot manipulator with similar functions to a human arm. Robotic arm system often consists of links, joints, actuators, sensors and controllers. The links are connected by joints to form an open kinematic chain. One end of the chain is attached to the robot base, and another end is equipped with a tool (hand, gripper, or end-effectors) which is analogous to human hand in order to perform assembly and other tasks and to interact with the environment. There are two types of joint which are prismatic and rotary joints and it connect neighbouring link.

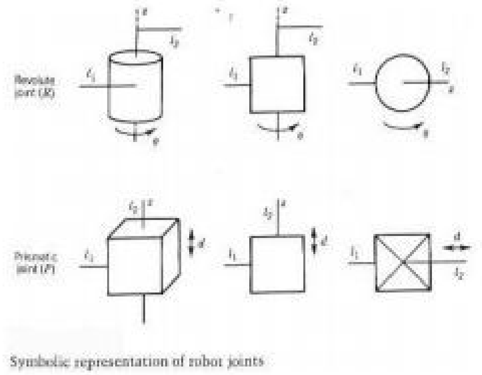

Fig. 3.10 FBD of joints of robotic arm

The links of the manipulator are connected by joints allowing rotational motion and the links of the manipulator is considered to form a kinematic chain. The Free Body Diagram for mechanical design of the robotic arm. A robotic arm with only four degrees of freedom is designed because it is adequate for most of the necessary movement. At the same time, it is competitive by its complexity and cost-saving as number of actuators in the robotic arm increases with degrees of freedom. In a robotic system, the number of degrees of freedom is determined by the number of independent joint variable.

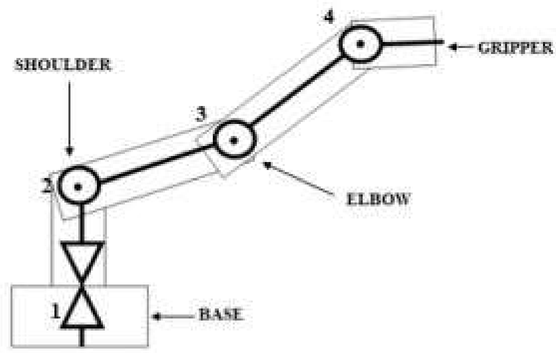

Fig. 3.11 Robotic arm

3.4.2.2 Wheels Movement

The wheels are mounted on a metal chassis along with the DC motors and is controlled by an Ultrasonic Sensor with the help of Arduino that helps it in avoiding obstacles.

Hardware

- Arduino Mega
- DC and Servo Motors
- Ultrasonic Sensors
- Motor Driver IC

Software

This requires Arduino IDE to be controlled.

3.4.3 Face Detection

Face recognition is an exciting field of computer vision with many possible applications to hardware and devices. Using embedded platforms like the Raspberry Pi and open source computer vision libraries like OpenCV, we have developed face recognition.

Hardware

- Raspberry Pi, model B, running the Raspbian operating system. Pi will need access to the internet to setup the software
- USB camera

Software

This project depends on the OpenCV computer vision library to perform the face detection and recognition.

Fig. 3.12 Face Recognition Training User 1

Fig. 3.13 Face Recognition Training User 2

3.4.3.1 Open CV Installation

1. Always good practice to update everything before you install stuff:

```
sudo apt-get update
sudo apt-get upgrade
```

2. We need to install some packages that allow OpenCV to process images:

```
sudo apt-get install libtiff5-dev libjasper-dev libpng12-dev
```

If you get an error about libjpeg-dev try installing this first:

```
sudo apt-get install libjpeg-dev
```

3. We need to install some packages that allow OpenCV to process videos:

```
sudo apt-get install libavcodec-dev libavformat-dev libswscale-dev libv4l-dev
```

4. We need to install the GTK library for some GUI stuff like viewing images.

```
sudo apt-get install libgtk2.0-dev
```

5. We need to install some other packages for various operations in OpenCV:

```
sudo apt-get install libatlas-base-dev gfortran
```

6. We need to install pip if you haven't done so in the past:

```
wget https://bootstrap.pypa.io/get-pip.py
sudo python get-pip.py
```

7. Now we can install NumPy - a python library for maths stuff - needed for maths stuff.

```
sudo pip install numpy
```

8. Download and install the file from this repo called "latest-OpenCV.deb".

```
wget "https://github.com/jabelone/OpenCV-for-Pi/raw/master/latest-OpenCV.deb"
sudo dpkg -i latest-OpenCV.deb
```

9. Test it installed correctly by doing the following: Open a python shell

```
Python
```

Run the following commands, it should return the same version you installed.

```
import cv2
cv2.__version__
```

3.5 PROGRAMME CODES

3.5.1 Program Code 1

The program code 1 refers to the code used for the Arduino Mega that is used to control the movement of DC motors along with ultrasonic sensors. The codes in Arduino are referred as Sketches.

```
const int trigger_middle=9;
const int echo_middle=8;

const int trigger_left=11;
const int echo_left=10;

const int trigger_right=13;
const int echo_right=12;
const int ML0=6,ML1=7,MR0=4,MR1=5;
const int middle_threshold=100;    //middle threshold
```

```
const int left_threshold=100;    //left
const int right_threshold=100;    //right
long Umiddle;
long Uleft;
long Uright;
void setup()
   {
      Serial.begin(9600);
      pinMode(trigger_middle, OUTPUT);
      pinMode(echo_middle, INPUT);
      pinMode(trigger_left, OUTPUT);
      pinMode(echo_left, INPUT);

      pinMode(trigger_right, OUTPUT);
      pinMode(echo_right, INPUT);
      pinMode(ML0,OUTPUT);
      pinMode(ML1,OUTPUT);
      pinMode(MR0,OUTPUT);
      pinMode(MR1,OUTPUT);
}
void loop()
{
   sensor();
 if(Umiddle>middle_threshold)
 forward();
 else if(Uleft>left_threshold)
 {
  left90();
 }
 else if(Uright>right_threshold)
```

```
  {
    right90();
  }
  else if (Uleft<left_threshold && Umiddle<middle_threshold && 
Uright<right_threshold)
  {
    R180();
  }
}
void sensor()
{
  long raw_middle;
  long raw_left;
  long raw_right;
     digitalWrite(trigger_middle, LOW);
     delayMicroseconds(2);
     digitalWrite(trigger_middle, HIGH);
     delayMicroseconds(10);
     digitalWrite(trigger_middle, LOW);
     raw_middle = pulseIn(echo_middle, HIGH);
     Umiddle = (raw_middle/2)/29.1;
     Serial.print(" middle \t");
     Serial.println(Umiddle);

     digitalWrite(trigger_left, LOW);
     delayMicroseconds(2);
     digitalWrite(trigger_left, HIGH);
     delayMicroseconds(10);
     digitalWrite(trigger_left, LOW);
     raw_left = pulseIn(echo_left, HIGH);
```

```
    Uleft =  (raw_left/2)/29.1;
    Serial.print(" left \t");
    Serial.println(Uleft);

    digitalWrite(trigger_right, LOW);
    delayMicroseconds(2);
    digitalWrite(trigger_right, HIGH);
    delayMicroseconds(10);
    digitalWrite(trigger_right, LOW);
    raw_right = pulseIn(echo_right, HIGH);
    Uright =  (raw_right/2)/29.1;

    Serial.print(" right \t");
    Serial.println(Uright);
    delay(400);
}
void forward()
{
  digitalWrite(MR0,HIGH);
  digitalWrite(MR1,LOW);
  digitalWrite(ML0,HIGH);
  digitalWrite(ML1,LOW);
}
void left()
{
  digitalWrite(MR0,HIGH);
  digitalWrite(MR1,LOW);
  digitalWrite(ML0,LOW);
  digitalWrite(ML1,LOW);
}
```

```
void right()
{
  digitalWrite(MR0,LOW);
  digitalWrite(MR1,LOW);
  digitalWrite(ML0,HIGH);
  digitalWrite(ML1,LOW);
}
void Hleft()
{
  digitalWrite(MR0,HIGH);
  digitalWrite(MR1,LOW);
  digitalWrite(ML0,LOW);
  digitalWrite(ML1,HIGH);
}
void Hright()
{
  digitalWrite(MR0,LOW);
  digitalWrite(MR1,HIGH);
  digitalWrite(ML0,HIGH);
  digitalWrite(ML1,LOW);
}
void pause()
{
  digitalWrite(MR0,LOW);
  digitalWrite(MR1,LOW);
  digitalWrite(ML0,LOW);
  digitalWrite(ML1,LOW);
}
void back()
{
```

```
  digitalWrite(MR0,LOW);
  digitalWrite(MR1,HIGH);
  digitalWrite(ML0,LOW);
  digitalWrite(ML1,HIGH);
}
void left90()
{
  left();
  do
  {
    sensor();
    left();
  }while(Umiddle<middle_threshold);
}
void right90()
{
  right();
  do
  {
    sensor();
    right();
  }while(Umiddle<middle_threshold);
}
void R180()
{
  right();
  do
  {
    sensor();
    right();
```

```
  }while(Umiddle<middle_threshold);
}
```

3.5.2 Program Code 2

The program code 2 refers to the code used for the Arduino Mega that is used to control the movement of ARM using Servo Motors.

```
#include <Servo.h>

Servo myservo1;
Servo myservo2;
Servo myservo3;
Servo myservo4;

int pos =0;
void handshakeR();
void handshakeL();

void setup()
{
  myservo1.attach(2);
  myservo2.attach(5);
  myservo3.attach(3);
  myservo4.attach(4);
 }
void handshakeR()
{
  myservo1.write(135);
```

```
  delay(100);
  for(pos=0;pos<=2;pos++)
  {
  myservo2.write(100);
  delay(500);
  myservo2.write(140);
  delay(500);
  }
}
void handshakeL()
{
  myservo3.write(135);
  delay(100);
  for(pos=0;pos<=2;pos++)
  {
  myservo4.write(100);
  delay(500);
  myservo4.write(140);
  delay(500);
  }
}

void loop()
{
  myservo1.write(90);
  for (pos = 80; pos <= 180; pos += 1)
  {
     myservo2.write(pos);
     delay(15);
  }
```

```
for (pos = 180; pos >= 80; pos -= 1)
{
    myservo2.write(pos);
    delay(15);
}
delay(1000);
handshakeR();
delay(2000);
handshakeL();
delay(1000);
}
```

3.5.3 Program Code 3

The program code 3 refers to the code used for generating the dataset used in face recognition in Raspberry Pi using USB Webcam

```
import cv2

cam = cv2.VideoCapture(0)

detector=cv2.CascadeClassifier('Classifiers/face.xml')

i=0

offset=50

name=raw_input('enter your id')

while True:

    ret, im =cam.read()

    gray=cv2.cvtColor(im,cv2.COLOR_BGR2GRAY)

    faces=detector.detectMultiScale(gray, scaleFactor=1.2, minNeighbors=5,
minSize=(100, 100), flags=cv2.CASCADE_SCALE_IMAGE)
```

```
    for(x,y,w,h) in faces:
        i=i+1
        cv2.imwrite("dataSet/face."+name +'.'+ str(i) + ".jpg", gray[y-offset:y+h+offset,x-offset:x+w+offset])
        cv2.rectangle(im,(x-50,y-50),(x+w+50,y+h+50),(225,0,0),2)
        cv2.imshow('im',im[y-offset:y+h+offset,x-offset:x+w+offset])
        if cv2.waitKey(100) & 0xFF == ord('q'):
            break
    # break if the sample number is morethan 20
        elif (i>20):
            break
cam.release()
cv2.destroyAllWindows()
```

3.5.4 Program Code 4

The program code 4 refers to the code used for training the dataset used in face recognition in Raspberry Pi using USB Webcam

```
import cv2,os
import numpy as np
from PIL import Image

recognizer = cv2.face.createLBPHFaceRecognizer()
cascadePath = "Classifiers/face.xml"
faceCascade = cv2.CascadeClassifier(cascadePath);
```

```
path = 'dataSet'


def get_images_and_labels(path):
    image_paths = [os.path.join(path, f) for f in os.listdir(path)]
    # images will contains face images
    images = []
    # labels will contains the label that is assigned to the image
    labels = []
    for image_path in image_paths:
        # Read the image and convert to grayscale
        image_pil = Image.open(image_path).convert('L')
        # Convert the image format into numpy array
        image = np.array(image_pil, 'uint8')
        # Get the label of the image
        nbr = int(os.path.split(image_path)[-1].split(".")[1].replace("face-", ""))
        #nbr=int(''.join(str(ord(c)) for c in nbr))
        print nbr
        # Detect the face in the image
        faces = faceCascade.detectMultiScale(image)
        # If face is detected, append the face to images and the label to labels
        for (x, y, w, h) in faces:
            images.append(image[y: y + h, x: x + w])
            labels.append(nbr)
            cv2.imshow("Adding faces to traning set...", image[y: y + h, x: x + w])
            cv2.waitKey(10)
```

```
    # return the images list and labels list
    return images, labels
images, labels = get_images_and_labels(path)
cv2.imshow('test',images[0])
cv2.waitKey(1)

recognizer.train(images, np.array(labels))
recognizer.save('trainer/trainer.yml')
cv2.destroyAllWindows()
```

3.5.5 Program Code 5

The program code 5 refers to the code used for detecting faces used in face recognition in Raspberry Pi using USB Webcam

```
import cv2
import numpy as np
import os

c=0
recognizer = cv2.face.createLBPHFaceRecognizer()
recognizer.load('trainer/trainer.yml')
cascadePath = "Classifiers/face.xml"
faceCascade = cv2.CascadeClassifier(cascadePath);

cam = cv2.VideoCapture(0)
```

```
fontface = cv2.FONT_HERSHEY_SIMPLEX
fontscale = 1
fontcolor = (255, 255, 255)
while True:
    ret, im =cam.read()
    gray=cv2.cvtColor(im,cv2.COLOR_BGR2GRAY)
    faces=faceCascade.detectMultiScale(gray, 1.2,5)
    for(x,y,w,h) in faces:
        cv2.rectangle(im,(x-50,y-50),(x+w+50,y+h+50),(225,0,0),2)
        Id = recognizer.predict(gray[y:y+h,x:x+w])
        if(Id<70):
            if(Id==1):
                Id="Shashank"
            elif(Id==2):
                if(c==0):
                    Id="Shivam"
                    c=c+1
                    os.system("espeak 'Welcome Shivam Access Granted'")
                  else:
                    Id="Shivam"


        else:
            Id="Unknown"
        cv2.putText(im, str(Id), (x,y+h), fontface, fontscale, fontcolor)
```

```
    cv2.imshow('im',im)
    if cv2.waitKey(10) & 0xFF==ord('q'):
        break
cam.release()
cv2.destroyAllWindows()
```

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 RESULTS

The hardware and software of the robot are working properly. Features which were decided, initially to be added in the robot are successfully implemented.

- The robot is moving forward, backward and take turns on the user's command and is equipped with sensors to avoid obstacles.
- The robot correctly imitates the hand motion of shaking hand and waving.
- Face detection is working properly and is giving access to the authorized user.
- It is speaking the coded message properly and the message can be changed in programming code of speech recognition.

4.2 LIMITATIONS

This robot is not AI based, it cannot learn from its surrounding and will work according to the changes made in the program.

The field of view of camera is limited to front of the robot, also height of the robot is not comparable to humans, detection is only possible if the camera sees the face of the person.

Robot doesn't move automatically but is controlled by the user, but it can automatically avoid obstacles or stop according to the surroundings.

Due to low RAM of Raspberry PI microcontroller there is delay in displaying the camera's view on screen.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

The report has covered history and development of humanoid robot which has similar structure as that of a human with movements controlled by certain motors.

The objective of this report was to give a detail information of how the robot is made and what all functions can the robot perform.

The successful completion of the project marked the achievement of goals that we started with. Like, we were able to move arms of the robot and made it shake hand and wave. These movements are programmed via Arduino Mega and can be changed according to requirements.

We have attached a camera which could record the video and the robot would only be accessed to the authorized person(s). It also recognizes people and deliver the message when the person is in the view of the camera. Message and number of people can be added in Raspberry Pi program.

All the objectives of the robot are met and there is still chance for improvement in the robot.

5.2 FUTURE SCOPE

Future scope of a project depends on two things:

- Limitations
- Its unused potential

We can add motor in the waist of the robot so that it could have a 360° rotation and legs so that the robot walks like humans.

Fingerprinting sensor can be added to the robot so that is gives authentication to the person whose data we have stored.

APPENDICES

APPENDIX-A

Arduino Mega 2560 PIN diagram

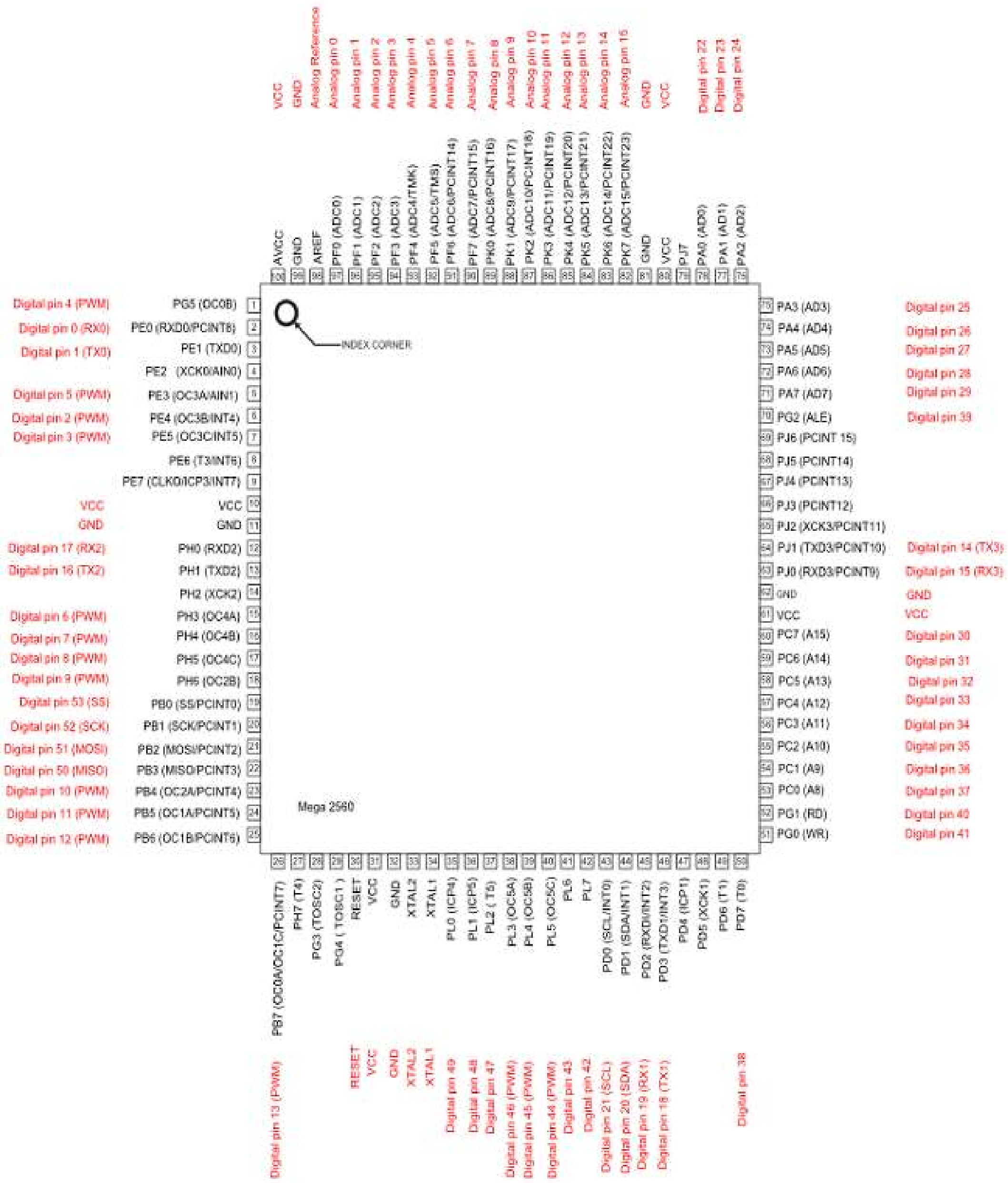

Fig. A.1 Pinout of Arduino Mega

APPENDIX B

HC-05 BLUETOOTH MODULE

How to use Bluetooth module?

The HC-05 has two operating modes, one is the Data mode in which it can send and receive data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed. We can operate the device in either of these two modes by using the key pin as explained in the pin description.

It is very easy to pair the HC-05 module with microcontrollers because it operates using the Serial Port Protocol (SPP). Simply power the module with +5V and connect the Rx pin of the module to the Tx of MCU and Tx pin of module to Rx of MCU as shown in the figure below

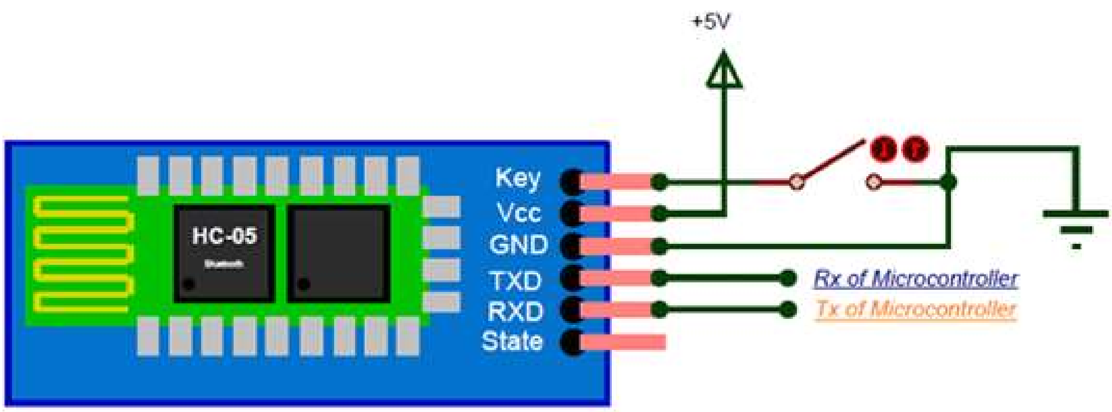

Fig. B.1 Interfacing of Bluetooth module

During power up the key pin can be grounded to enter into Command mode, if left free it will by default enter into the data mode. As soon as the module is powered you should be able to discover the Bluetooth device as “HC-05” then connect with it using the default password 1234 and start communicating with it.

APPENDIX C

RASPBERRY PI 3

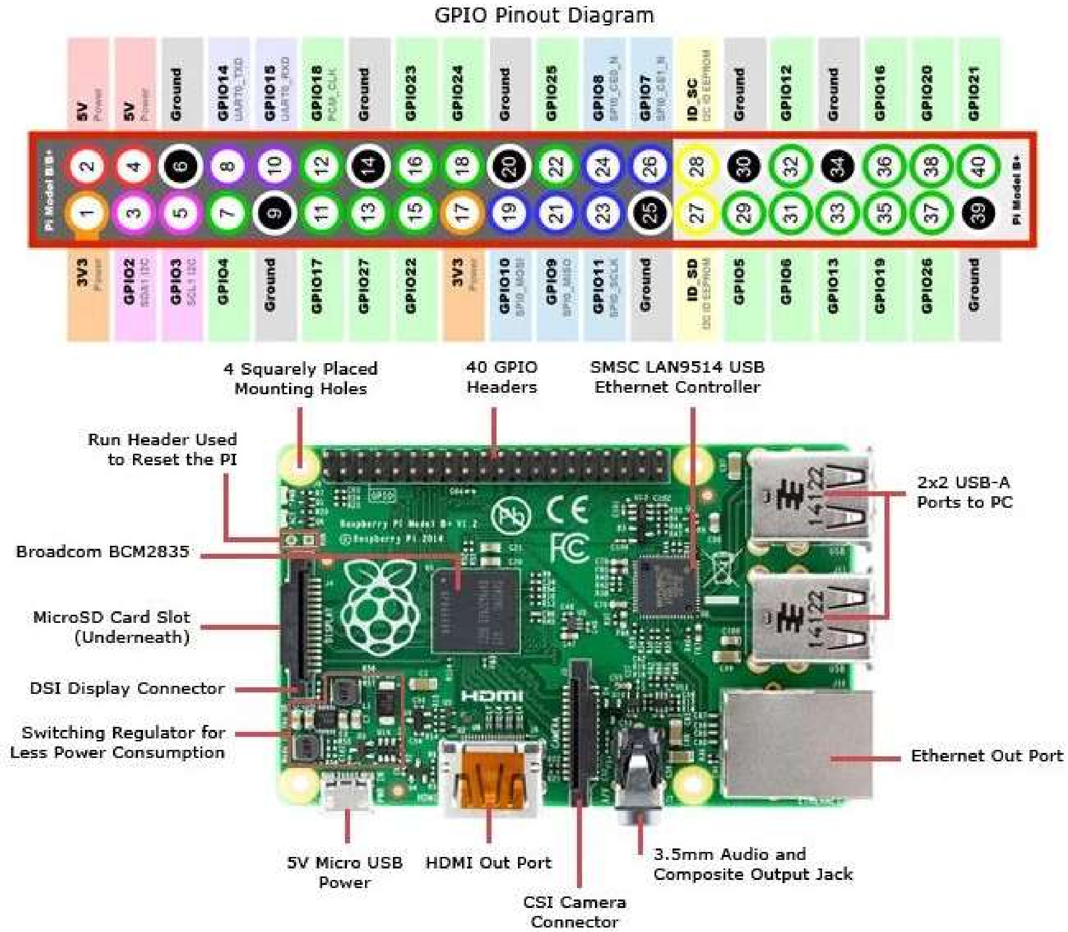

Fig. C.1 Pinout of Raspberry PI

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CURRICULUM VITAE

Ph : 7895779923

E-mail: shubham7.8.96@gmail.com

Name: SHUBHAM KUMAR

Objective

To be a team player and contribute as an efficient professional, utilizing my analytical and technical skills to serve the Organization. I also like to work in a fast paced (challenging) environment and I'm enthusiastic to explore new technologies.

TECHNICAL SKILLS SUMMARY

Platforms: Windows, Unix/Linux

Programming Languages/Technologies: Java, Big Data, Map Reduce, HQL(Hive Query Language), Shell Scripting(Linux), C-language, HTML, CSS, JavaScript, Salesforce Trailhead.

Database: MySQL.

Tools: Apache Hadoop(Hive ,Pig, Sqoop ,Flume , HBase) ,Cloudera ,Eclipse, Lightening Experience,Trailhead.

PROJECT DETAILS

1. **Data Analysis Of NYC dataset**

New York City complaint Data Set
New York city maintain dataset of their complains. Every Day complain status is getting updated and new complain raised. New York City has many agency/Department to report complain. Each agency/Department has many different Complain type. Complain contain many parameters like Type, Date, Zip, Address, status, etc.

Challenges/Tasks:-To Find top 10 complaint types. How many distinct complaint types are there?. Top 3 Incident Zip codes with complaints. To Find all complaint types happens in 'street' .
Technologies/Tools used: Java, Hadoop, MapReduce, Hive, Sqoop, HBase.

2. **Project: Humanoid Robot**

Challenges/Tasks:- Face Detection for authentication of user, and providing Response by controlling gestures of robot.

Technologies/Tools used:- Embedded systems, RasberryPi, Bluetooth Module, Servo Motors, Ultrasonic sensors, camera.

Educational Qualifications

COURSE	INSTITUTION	UNIVERSITY	YEAR OF PASSING	AGGREGATE
10^{th}	City Vocational Public School	C.B.S.E	2012	81%
12^{th}	City Vocational Public School	C.B.S.E	2014	81%
B.Tech(EC)	Meerut Institute Of Engineering and Technology	A.P.J Kalam Technical University	2018	68.02%

ACHIEVEMENTS

- Certification on Big Data (Hadoop, MapReduce, Pig , Hive , Sqoop , Flume , HBASE.)
- Certification on Frontend Web Development in(HTML,CSS,JavaScript)
- Embedded training on Aurdino Microcontroller.
- Certified workshop on Embedded Robotics.
- Two times All india top 50 Rank Holder in TI(Texas Instruments University Program).
- Certified on Salesforce Trailhead Declarative Development for Platform App Builders (DEV402).

Extra Curricular Activities/Skills

- Participated in Quiz competitions such as All India TI(Texas Instruments University Programme).
- Participated in college level Debate Competition.
- Participated in National level Robotics Championship organized by MIET,Meerut .

Personal Profile

Name	:	SHUBHAM KUMAR
Address	:	241/242 KRISHAN PURI DELHI GATE,MEERUT
Father's Name	:	Mr.ASHOK KUMAR
Date of Birth	:	07/08/1996
Sex	:	MALE
Marital status	:	UNMARRIED
Nationality	:	INDIAN
Languages Known	:	HINDI,ENGLISH

DECLARATION

I hereby declare that the above mentioned information is correct up to my knowledge and I bear the responsibility for the correctness of the above mentioned particulars.

DATE:28/04/2018 **Shubham Kumar**

SHIVAM SHUKLA

L/21-Q, Loco Colony
Mawaiya, Lucknow-226004
Mobile: 8172815456
Email: shivamshukla191@gmail.com

Objective

Seeking a demanding position in a reputed industry to work and become familiar with the nuances of professional skills needed to pursue my career.

Education

Course	Institution	Board/Branch	Percentage	Year of Completion
B.Tech	Meerut Institute of Engineering & Technology, Meerut	Electronics and Communication Engineering	72%	2018
Intermediate	Lucknow Public School	I.S.C	86%	2013
High School	Lucknow Public School	I.C.S.E	88%	2011

Technical Skills

- **Hardware:** PCB Fabrication, Soldering, MSP-430, AVR, Arduino, RaspberryPi.
- **Programming Languages:** Embedded C, Python Basics.
- **Software Applications:** AVR Studio, Eagle, Matlab, Keil, OrCad, PSpice, Adobe InDesign, Adobe Photoshop, Lightworks, Code Composer Studio.

Projects

- **Autonomous Robot***:* Made a robot which could follow a line, avoid collisions and also avoid falling from the edges using AVR ATMEGA16.
- **LED Cube:** Made a 3*3*3 led cube to display various patterns using Arduino.
- **Astable Multivibrator:** Designed and fabricated its circuit using 555 timer, learning Eagle and Soldering.
- **LED Clock:** Made a analog rotating real time clock based on MSP-430 and persistence of vision.
- **Smart Car Parking :** Designed Smart Car Parking System using Raspberry Pi and IOT.

Training

- **TEXAS INSTRUMENTS** - INTERNSHIP PROGRAM IN MICROCONTROLLER BASED EMBEDDED SYSTEM DESIGN, Texas Instruments – Centre for Embedded Product Design, Netaji Subhas Institute of Technology, Delhi – (June 06, 2016 – July 01, 2016).
- **INTERNSHALA** – Online Web Design Training using HTML, CSS, MySQL-(June 1 – July 13, 2017).
- **EXPERTS HUB**: Internship on IOT using Raspberry Pi at ExpertsHub Training Center, Bangalore-(July 24,2017 - July 31,2017).

Co-Curricular And Achievements

- Idea selected for TI-DST India Innovation Challenge 2017 and currently in second round.
- Working member and lead designer of SEE-MIET (Society of Electronics Engineers - MIET).
- Organized various literary events under the name of Odyssey, the literary committee of college.
- Organized GLITZ, the annual literary fest of the college for three years - 2015,2016 & 2017

Declaration:

I, hereby declare that the above information is true and best of my knowledge.

Place: Meerut
Date: 28th April, 2018 **Shivam Shukla**

SHASHANK BHARDWAJ

Email: shashank2218@gmail.com
Mobile no.: 9761867982
College: Meerut Institute of Engineering and Technology, Meerut

---

Career Objective:

To work in a firm where I can utilize and apply my knowledge, skills which would enable me to grow while fulfilling organizational goals.

Basic Academic Credentials:

Qualification	Board/University	Year	Percentage/CGPA
B.Tech (Electronics and Communication Engineering)	Meerut Institute of Engineering and Technology, Meerut (AKTU)	2014-2018	79.30%
XII (Senior Secondary)	Army Public School, Meerut Cantt. (CBSE)	2013	85.40%
X (Secondary)	KV no. 1, Suratgarh (CBSE)	2011	CGPA: 10/10

Trainings:

1. **Embedded Systems**
   University: UT Austin (Online) Duration: Jan 2016 - May 2016
   Description: Training on Texas Instruments micro-controller Tiva TM4C.

2. **Machine Learning**
   University: Sanford University (Online) Duration: May 2016 – Aug 2016
   Description: Leaning about various aspects of artificial intelligence, machine learning and fuzzy system.

3. **Summer training on Embedded Systems**
   Location: NSIT, New Delhi Duration: Jun 2016 – July 2016
   Description: Training on Texas Instruments' microcontroller MSP430.

4. **Mobile Computing with App Inventor**
   University: Trinity University (Online) Duration: Feb 2017 – March 2017
   Description: Creating android apps using App Inventor

5. **Summer training on CNC machine**
   Location: BHEL, Haridwar Duration: 15 Jun, 2017 - 14 July, 2017
   Description: Learning about Computer Numeric Control machines.

Projects:

1. **Line Follower Robot**

   Description: A line follower robot using Atmega 16 microcontroller.

2. **Propeller Clock**

   Description: A rotating analog clock which uses persistence of vision to show time, using MSP430 microcontroller.

3. **Walking Tour App**

   Description: An android app which describes the saved location when a person reaches the coordinate.

4. **Nain 1.0**

   Description: A humanoid robot with image and sound processing

Skills:

- **Language:** C Programming, C++ Programming
- **Software:** Microsoft Office, Adobe InDesign, MATLAB, LabVIEW, Eagle
- **Electronics:** Embedded Systems, Robotics, Arduino
- **Database:** MySQL
- **Web Designing:** HTML, CSS
- **Operating System:** Microsoft Windows

Position of Responsibility and Achievements:

- Editor of Electronics and Communication Department magazine at college.
- Active member of electronics lab in college. Work on organizing things and giving presentations.
- Got a certificate of achievement in online test of Texas Instruments.

Interpersonal Skills:

- Ability to cope up with different situations and can work under high pressure.
- Ability to reach effective solutions to any kind of problem.
- Good communication skills.

Personal Details:

- **Father's Name:** Mr. Vinod Kumar
- **Date of Birth:** 22nd January, 1996
- **Languages:** English and Hindi
- **Hobbies and Interests:** Playing basketball, chess, solving puzzles.

Declaration:

I, hereby declare that the above information is true and best of my knowledge.

Place: Meerut

Date: 28th April, 2018 **Shashank Bhardwaj**