PIMPRI CHINCHWAD EDUCATION TRUST'S

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE- 411044.

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION B.E. (E&TC) 2021-2022

PROJECT REPORT REVIEW 1&2

CHEERBOTIX 2.0

Project ID: C105

Name of Students	Roll no.
M/s. Sakshee Kolhe	BEETC317
Mr. Manthan Choudhury	BEETC321
M/s. Bhagya Pillai	BEETC338

Prof. A. B. Patil
Course Coordinator

Dr. M. T. Kolte
HoD (E&TC Dept.)

2021-2022

CERTIFICATE

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING
SAVITRIBAI PHULE UNIVERSITY OF PUNE, PUNE.

2021-22

Project Report
On CHEERBOTIX 2.0

Submitted for Partial Fulfillment of the Requirements for the Degree of Bachelor of Engineering in the Department of Electronics & Telecommunication Engineering Pimpri Chinchwad College of Engineering, Savitribai Phule University of Pune, Pune

By

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M/s. Sakshee Kolhe	BEETC317
Mr. Manthan Choudhury	BEETC321
M/s. Bhagya Pillai	BEETC338

Prof. A. B. Patil
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ABSTRACT

Dance as a form of performing arts includes a wide range of social behaviours, is an important means of communication, is a useful tool for psychological and physical therapy and is a natural means of emotional expression.

Robotic dance has attracted interest in the field of social robotics, and dancing robots can perform many kinds of robotic dances. In general, robotic dance has many social effects in society: 1) It is a kind of interactive social behaviour, in particular human–robot interaction and animal activity, 2) it is a way to express the emotions or intentions of robots through nonverbal communication, 3) it is a treatment and therapy for a wide range of illnesses, including autism, developmental disorders, and attention deficit and cognitive disabilities.

Dancing robots involve the exploration of the physical hardware structures, kinematics, dynamics, and the automation of a robot so it can dance. On the other hand, robotic dance is an expressive form of the art of dance performed by robots and is focused on how to make a robot dance as a human does, and how a robot creates and performs beautiful dance.

In addition to these a hand gesture recognition system that allows interaction with robot in dynamic environment and in real-time is purpose the system detects hand and static gestures and moves accordingly.

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Chapter 1

INTRODUCTION

1.1 Background

In beginning, robots were only used for a singular function or purpose that is as an aid to human in industrial applications. Nowadays, the robot is not only assigned to do work but also for entertainment purpose. Gesture recognition is an important area of research in the field of computer vision. Gesture recognition pertains to recognizing meaningful expressions of motion by a human, involving the hands, arms, face, head or body with the intention of conveying meaningful information or interacting with the environment. In addition to the theoretical aspects, any practical implementation of gesture recognition typically requires the use of different imaging and tracking devices or gadgets. Gestures can be static (the user assumes a certain pose) or dynamic. Direct use of the hand as an input device is an attractive method. This may increase the interest of people in robotic world.

1.2 Problem Statement

Several hand detection and hand gesture recognition systems have been proposed. Early systems usually require markers or coloured gloves to make the recognition easier. Second generation methods use low-level features as color (skin detection), shape or depth information for detecting the hands. However, those systems are not robust enough for dealing with dynamic conditions; they usually require uniform background, uniform illumination, a single person in the camera view, and/or a single, large and centered hand in the camera view. But in our proposed model (Cheerleader) should dance, move freely and performs dance on the music. Dancing robot should grab the attention of people with their ability to dance and aesthetics. Also robot should detect hand, static and dynamic gestures in real-time environment. According given hand input robot should move accordingly.

1.3 Motivation / Need of project

The motivation for gesture recognition is to develop a system which can detect the gestures and these gestures are widely used for conveying the information or to control the devices. Camera based solutions for gesture recognition has been widely used in numerous applications and capability to communicate through Human Computer Interaction.

1.4 Objective and Scope of the Project

- To design dancing robot that will dance according to the programmed movement along with the chosen music within a specific time frame.

- To recognise static and dynamic hand gesture in real time.
- To move the robot according to the given hand gesture.
- To write a program so that robot will change volume according to hand gesture.

Chapter 2

LITERATURE SURVEY

During literature review, we came across various journals, conference papers, articles and Newsletters.

The details of literature survey are given below:

Going through different articles and journal papers intrigued the team to analyse how we can build human interactive robot. In Arduino Controlled Car Bluetooth module were used to control Arduino microcontroller and hence car was controlled by using Arduino and Bluetooth.

In Robotic Dance in Social Robotics—A Taxonomy research paper, researchers have divided robotic dance into several categories and explained each of them very well. Categories are as follows:1. cooperative human robot dance 2. Imitation of human dance 3. Synchronization of music and 4.Robotic choreography. In that we have studied synchronization and choreography part but given paper is not sufficient for physical structure, hardware of dancing robot and a robot to synchronize its dance to various music types harmoniously as a human does.

In An Efficient Method for Composing Whole Body Motions of a Humanoid Robot we investigated an approach of Concatenating small dance performances to give large variation in final dance.

In The design of face recognition and tracking for human-robot interaction paper we studied about how Python 2.7 (with the OpenCV library) by using Cascade Classification and LBPH Face Recognizer method can be used and which has a good accuracy rate (92.73%). Also, the implementation of facial tracking to control 12 DoF of Social Robot SyPEHULbased on Arduino microcontroller.

For detecting human hand we can use various different tools and algorithms. After going through various research papers we have decided to use Python and OpenCV library to detect human hand in dynamic and run time environment.

Table 1: Literature Survey

Sr. no	Title of the Paper	Year of Publication/ Publisher	Methodology	Conclusion
1.	Arduino droid Controlled Car	May 2016 AmanpreetKaur, Abhishek Mani Tripathi, GopalKushwaha, InzmamulHaque International Journal of Computer Science	Controlling Arduino using Bluetooth module	Bluetooth module need to be used to control Arduino microcontroller
2.	Robotic Dance in Social Robotics—A Taxonomy	June 2015 HuaPeng, Changle Zhou, Huosheng Hu, Fei Chao, and Jing Li IEEE Trans. IEEE TRANSACTIONS ON HUMANMACHINE SYSTEMS	Interacting reinforcement learning for synchronization in robots	Consideration of music rhythm, beats and tempo of music while choreographing dance performance.

3.	An Efficient Method for Composing Whole Body Motions of a Humanoid Robot	2007 Shinichiro NAKAOKA† Atsushi NAKAZAWA‡ Katsushi IKEUCHI Institute of Industrial Science, The University of Tokyo	Humanoid robot performances	Concatenation of small dance performances to give large variation in final dance.
4.	The design of face recognition and tracking for human-robot interaction	2017 2nd International conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE)	This paper discusses the development of SocialRobot named SyPEHUL (System of Physic, Electronic, HumanoidRobot and Machine Learning) which can recognize and trackinghuman face.	This paper gives insight about how Python 2.7 (with the OpenCV library) by usingCascade Classification and LBPH Face Recognizer method can be used and which has a good accuracy rate (92.73%). Also, the implementation offacial tracking to control 12 DoF of Social Robot SyPEHULbased on Arduino microcontroller.

5.	Real-Time Hand Gesture Recognition for Human Robot Interaction	RoboCup 2009: Robot Soccer World Cup XIII [papers from the 13th annual RoboCup International Symposium, Graz, Austria, June 29 - July 5, 2009]	The whole gesture recognition system in this paper was evaluated in real video sequences obtained in office environments with dynamic conditions of illumination and background.	This paper built the service robot who interact with the human user at a variable distance of one to two meters.

Chapter 3

METHODOLOGY

3.1 Block diagram

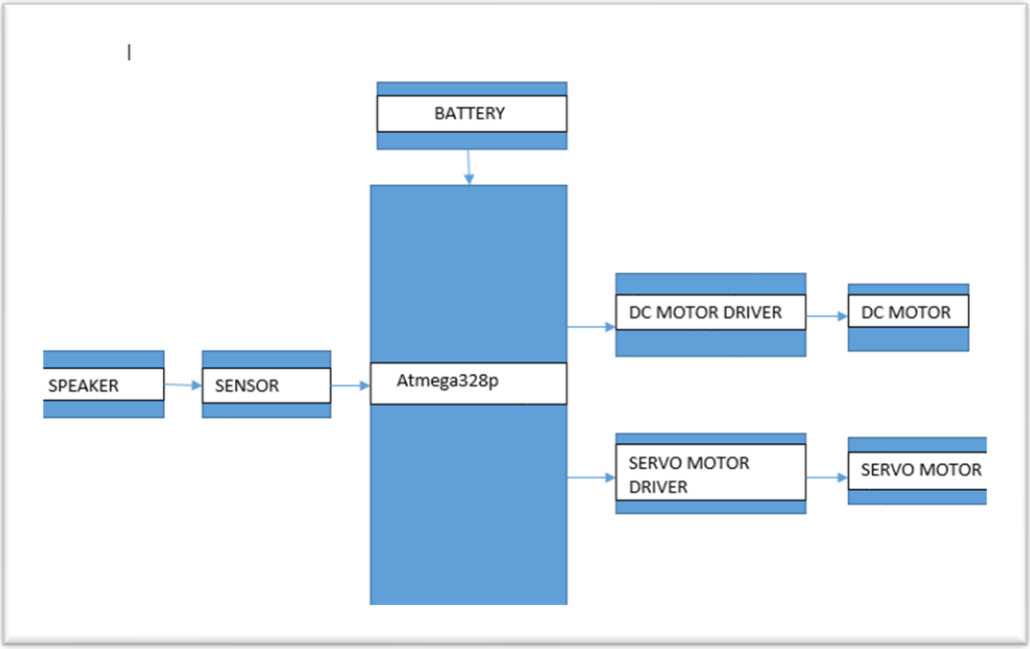


Fig 1: Block Diagram

Elements of block diagram:

- Atmega328p
- Sound sensor
- Cheerleader
- DC Motor
- Servomotor

Block diagram explanation:

ATMEGA328P: The high-performance Microchip pico Power 8-bit AVR® RISC-based microcontroller combines 32 KB ISP Flash memory with read-while-write capabilities, 1024B EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented Two-Wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

Sound sensor: Sound Sensor can detect the sound intensity of the environment. The main component of the module is a simple microphone, which is based on the LM386 amplifier and an electret microphone. The output of sound sensor is divided into nine levels and each level is assigned with one dance pattern.

Cheerleader: When dance program stored in microcontroller is being executed cheerleaders will dance according to stored program. We have programmed nine dance patterns for each sound level of the music. According to the sound levels it will select one dance pattern out of nine. Each dance pattern having different choreography for that we are rotating some motors with some delays. So, it seems like dancing steps.

CHAPTER 4
HARDWARE IMPLEMENTATION

4.1 Hardware specifications / requirements

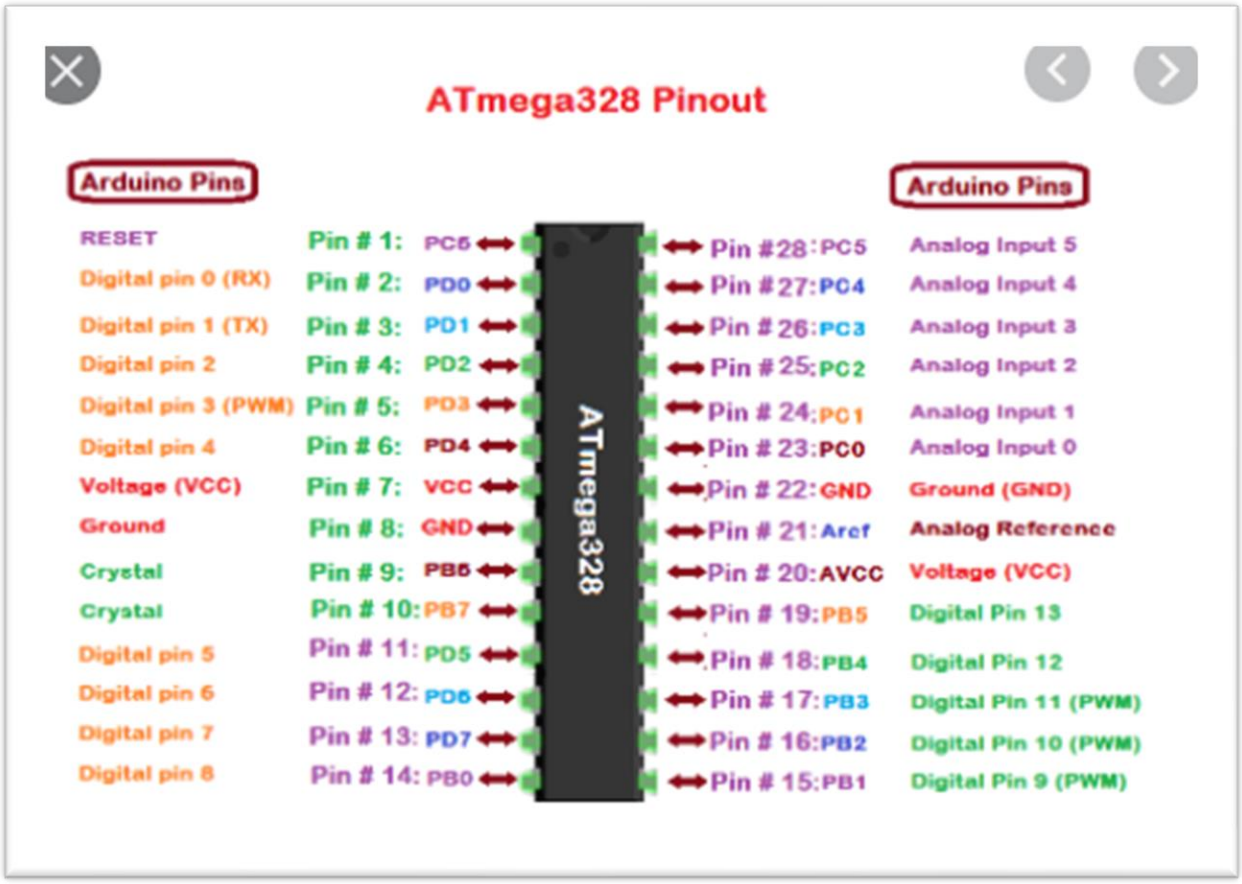


Fig 2: Pin Diagram ATMEGA328P

Features:

- Operating Voltage (logic level): 5 V
- Input Voltage (Recommended): 7-12 V
- Input Voltage (limits): 6-20 V

- Digital I/O Pins: 14 (of which 6 provide PWM Output)
- Analog Input Pins: 8
- DC Current per I/O Pin: 40 mA
- Flash Memory:16/32 KB (ATmega328) of which 2 KB used by bootloader
- SRAM: 1/2 KB (ATmega328)

4.2.DC motor:

Fig 3: DC MOTOR

Specifications:

- Torque: 2Kg-cm Rotational speed (No load): 10 rpm
- Operating voltage: 12V
- Current: 0.20A (no load), 1.25A (max)

4.3 Servo Motor:

Fig 4. Servomotor

Specifications:

- Model no:SG90
- Operating voltage:4.8-7.2 volts
- Speed:0.17-0.14 seconds
- Torque:9.4-11 kg/cm
- Dimensions:41x20x43

4.4 Motor driver (L293D):

Fig 5: MotorDriver

Specifications:

- Supply voltage: 12V
- Peak Output Current: - 600mA
- VCC: 5V

4.5 VMA309 MICROPHONE SOUND SENSOR MODULE:

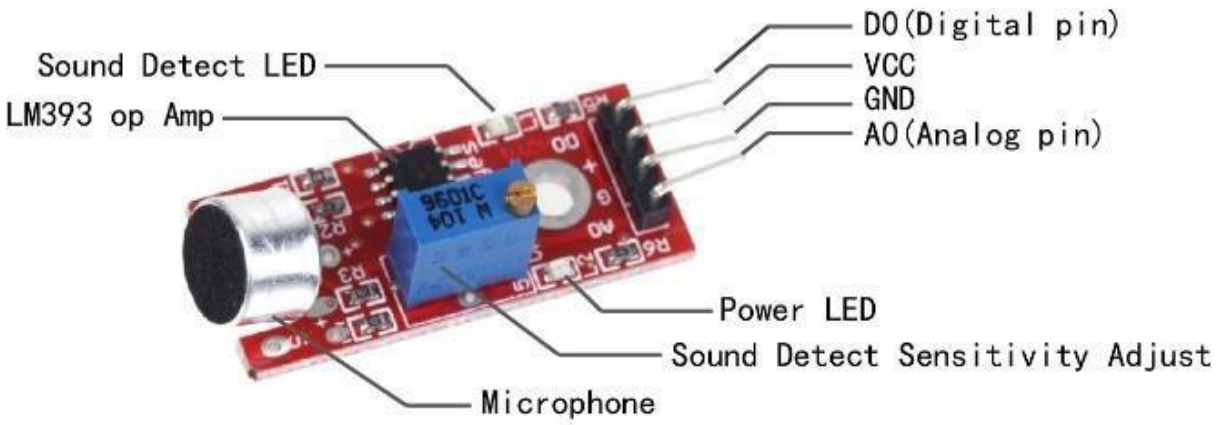


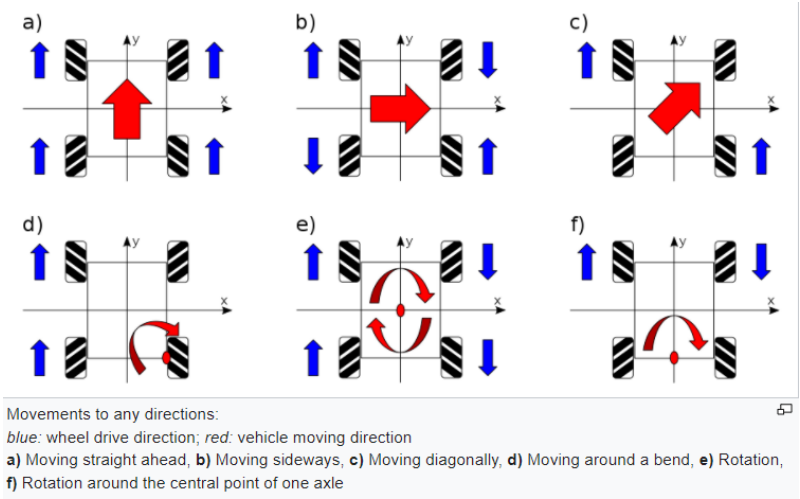
Fig 6: **MICROPHONE SOUND SENSOR MODULE**

Specifications:

- Voltage: 3.3-5V
- 2 indicator LEDs:1 power indicator + 1 comparator output indicator
- Frequency response:50 Hz - 20 KHz
- Impedance :2.2 kΩ
- Sensitivity :48-66 dB
- Operating temperature: -40 ℃ to +85 ℃
- Dimensions :44 x 15 x 10 mm
- Weight: 4 g

4.6 Mecanum Wheel :

Fig 7: Meacnum Wheel



Movements to any directions:
blue: wheel drive direction; *red:* vehicle moving direction
a) Moving straight ahead, **b)** Moving sideways, **c)** Moving diagonally, **d)** Moving around a bend, **e)** Rotation, **f)** Rotation around the central point of one axle

Fig 8: Working of Mecanum Wheel

The Mecanum wheel is an omnidirectional wheel design for a land-based vehicle to move in any direction. It is sometimes called the Swedish wheel or Ilon wheel. The Mecanum wheel is based on a tireless wheel, with a series of rubberized external rollers obliquely attached to the whole circumference of its rim. These rollers typically each have an axis of rotation at 45° to the wheel plane and at 45° to the axle line.[3] Each Mecanum wheel is an independent non-steering drive wheel with its own powertrain, and when spinning generates a propelling force perpendicular to the roller axle, which can be vectored into a longitudinal and a transverse component in relation to the vehicle.

CHAPTER 5

SOFTWARE IMPLEMENTATION

5.1 Arduino IDE

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. It can be used for other boards by simply adding the library of that board.

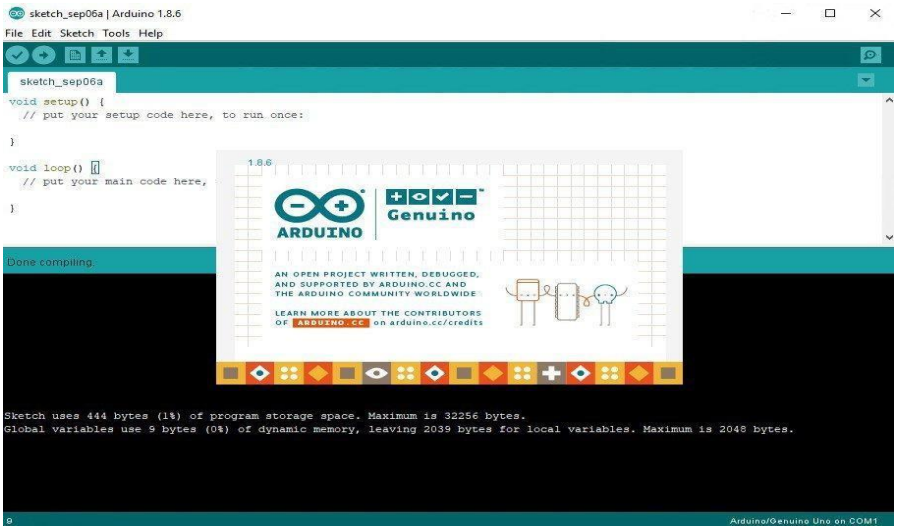


Fig 9: **ArduinoIDE**

5.2 Proteus 8

Fig 10: Proteus Software Logo

Proteus is a simulation and design software tool developed by Lab center Electronics for Electrical and Electronic circuit design.

About Proteus, It is a software suite containing schematic, simulation as well as PCB designing. ISIS is the software used to draw schematics and simulate the circuits in real time. The simulation allows human access during run time, thus providing real time simulation. ARES is used for PCB designing. It has the feature of viewing output in 3D view of the designed PCB along with components. ISIS has wide range of components in its library. It has sources, signal generators, measurement and analysis tools like oscilloscope, voltmeter, ammeter etc. probes for real time monitoring of the parameters of the circuit, switches, displays, loads like motors and lamps, discrete components like resistors, capacitors, inductors, transformers, digital and analog Integrated circuits, semi-conductor switches, relays, microcontrollers, processors, sensors etc.

5.3 OpenCV (Python Library)

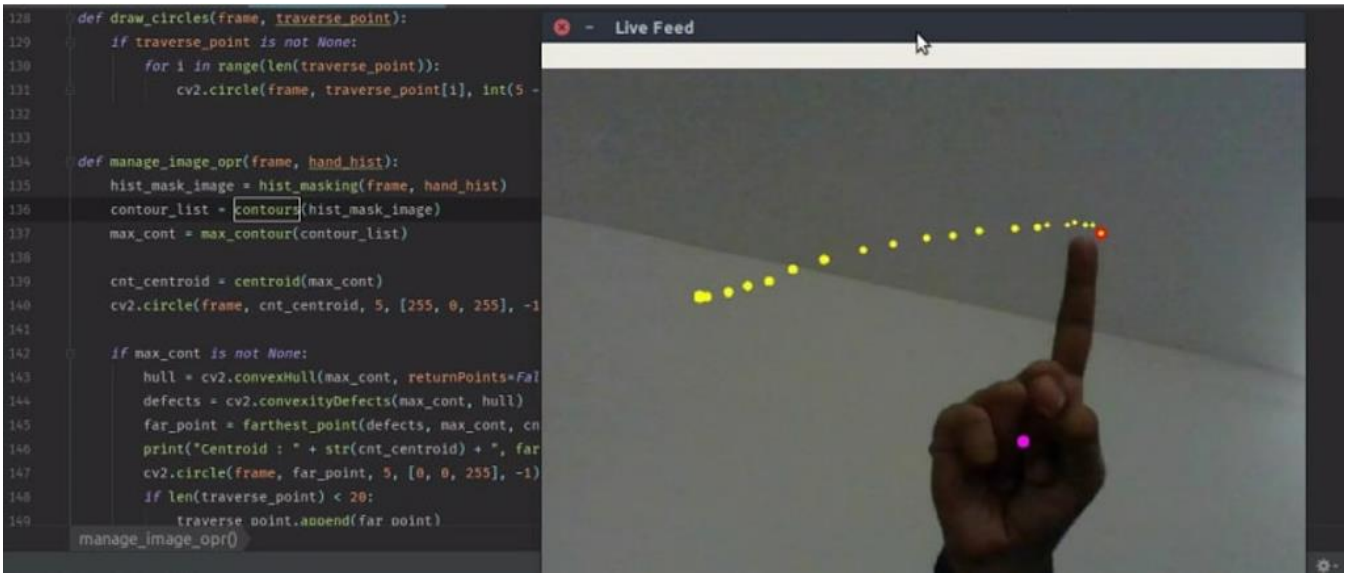


Fig 11: OpenCV Software Logo

OpenCV (*Open Source Computer Vision Library*) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source Apache 2 License. Starting with 2011, OpenCV features GPU acceleration for real-time operations. Officially launched in 1999 the OpenCV project was initially an Intel Research initiative to advance CPU-intensive applications, part of a series of projects including real-time ray tracing and 3D display walls. The main contributors to the project included a number of optimization experts in Intel Russia, as well as Intel's Performance Library Team.

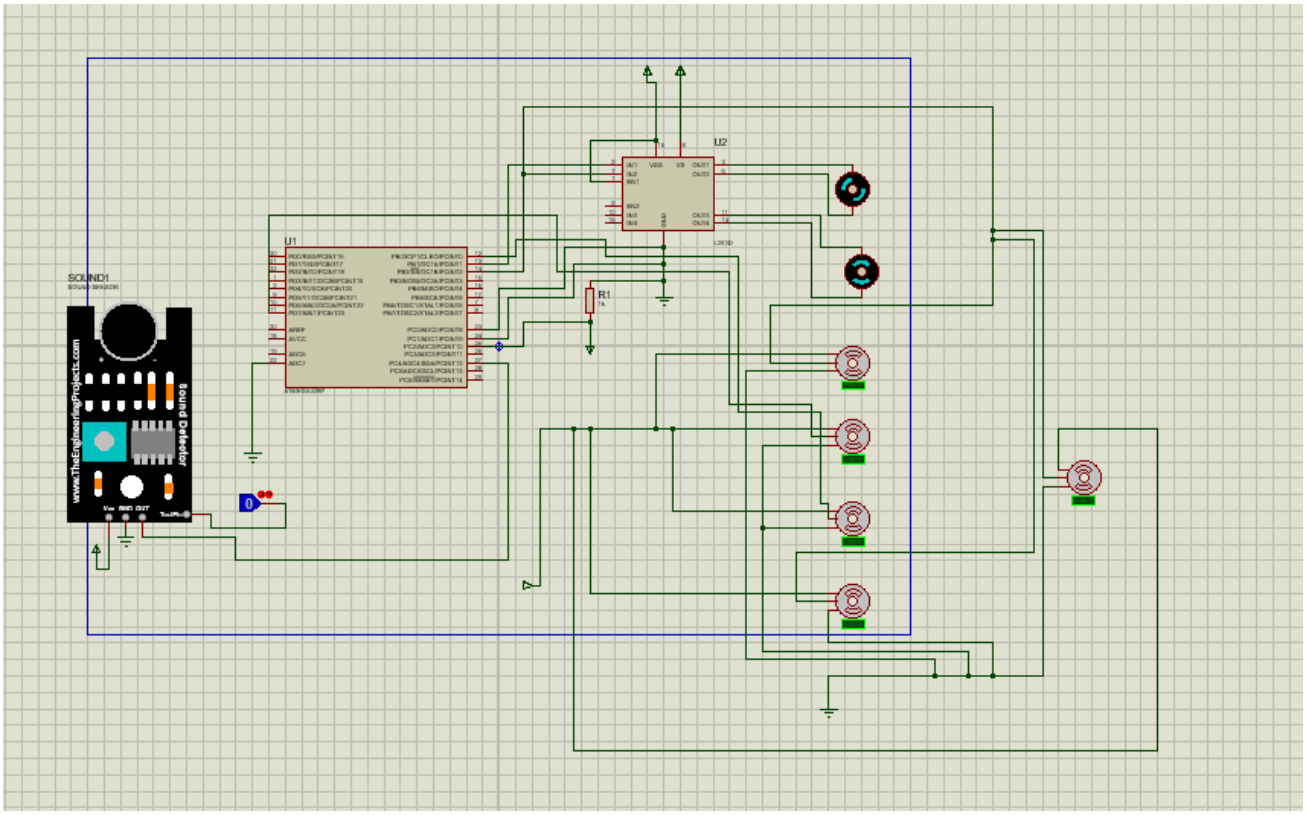


Fig 12: Schematic of simulation -1

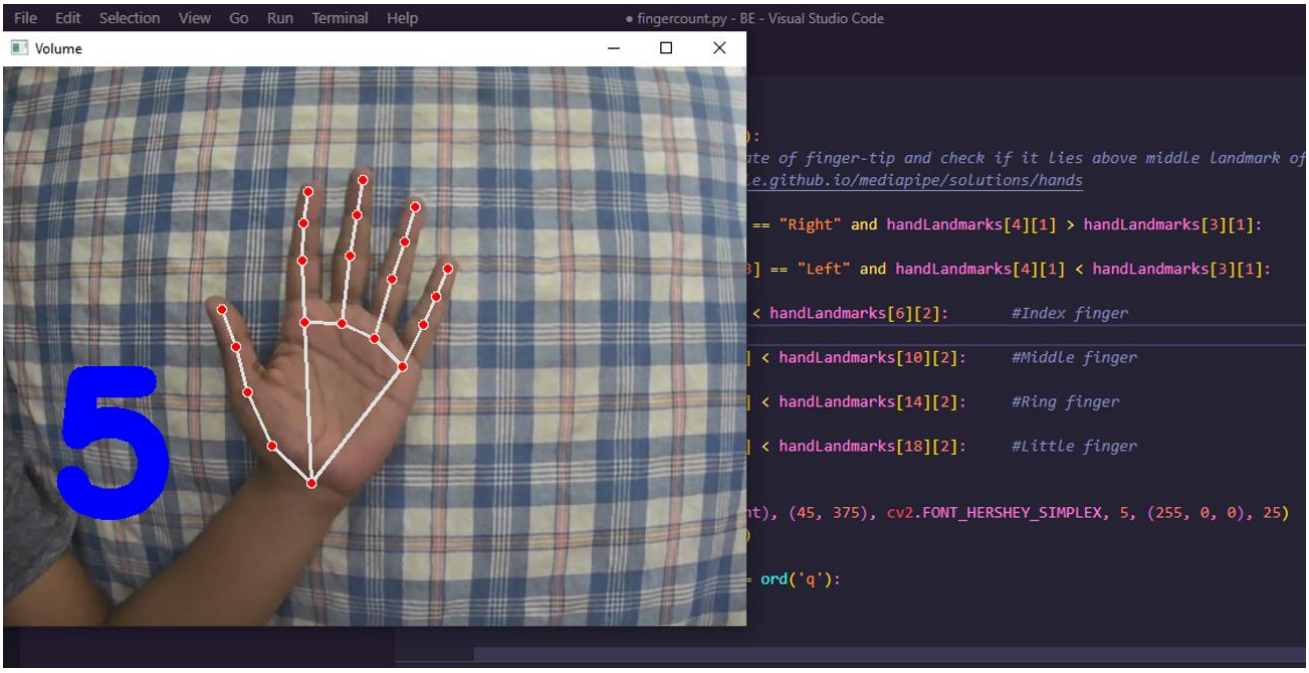


Fig 13: Schematic of simulation -2

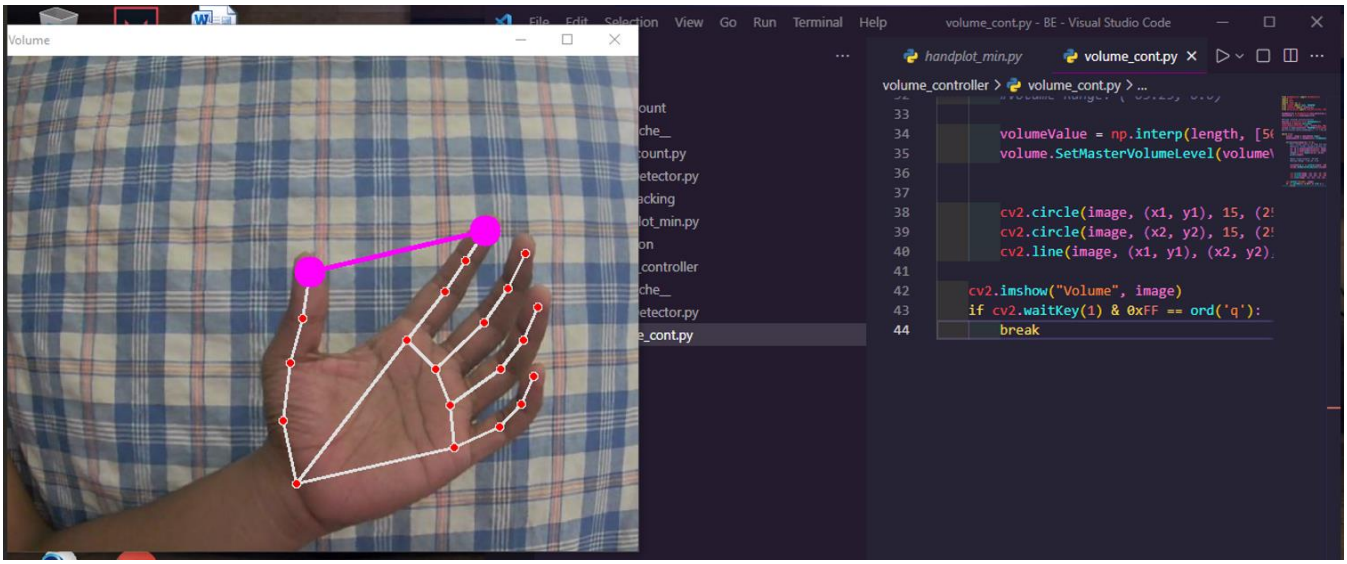


Fig 14: Schematic of simulation -3

CHAPTER 6

APPLICATIONS

7.1 Applications:

1. Wireless controlled robots are very useful in many applications like remote surveillance, military etc.
2. Hand gesture controlled robot can be used by physically challenged in wheelchairs.
3. Hand gesture controlled industrial grade robotic arms can be developed.
4. Entertainment applications – The main application of our project is for entertainment as our cheerleaders are dancing. Their smooth movement while dancing, captures everyone's heart. Most videogames today are played either on game consoles, arcade units or PCs, and all require a combination of input devices. Gesture recognition can be used to truly immerse a players in the game world like never before

CHAPTER 7
CONCLUSION & FUTURE SCOPE

8.1 EXPECTED CONCLUSION:

- Robot should dance according to the programmed movement along with the chosen music within a specific time frame.
- Robot should be able to recognise static and dynamic hand gesture in real time.
- Robot should move according to the given hand gesture.

8.2 FUTURE SCOPE:

- **Traffic control**: Whenever there is huge traffic at signal by proving sensors to system, they could sense the density of the traffic and the lane where traffic is more the robot will turn to that lane and the traffic of that lane will be released first.
- **Gaming**: As we are providing hand, leg, neck movements to robot thus by sensing opponent robot's movement we can we system for gaming application.
- **Household purpose**: By little modification in the system robots can be used for serving, cleaning etc. There is hotel in China wherein waiters are not human beings but the robots.

CHAPTER 8

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