Robotics in Music Industry

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Abstract : *Robotics and music are two independent field operation, that plays important role in public sector the purpose of this research paper is to re-visit the literature on both concept and co-relates them in technical terminologies I had done deep research on robot performance and studied more about music instruments which concludes me about to see the exciting results of combination of these two.*

Keywords: Robotics, Music, Servo motors, Arduino nano

I. Introduction

Today almost every engineer is familiar with robotics while music is their co-curricular part in their academic year[1]. we, as an engineer combine this two and trying and experiment and really excited with the results as it quite more innovative to watch these two different sectors performing in a single stage. Robots and music instruments are providing the best class level service. The interesting part of these is we never seen before of combination of these two. With the accuracy and precise work of robotic and music is favourite among all the age group of life, a new generation of music is coming soon.

Defining Robot and Music

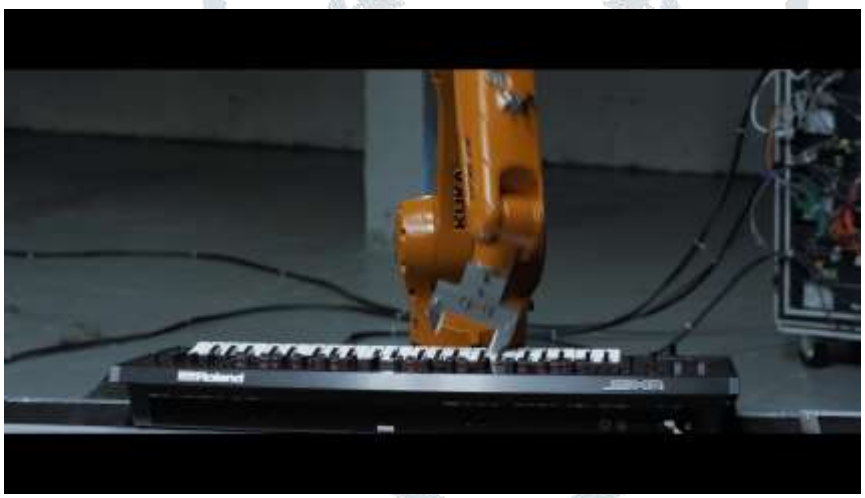

Fig. 1. Music playing robot

Robot-minimum 4DOF(degree of freedom) can be the best part for type of operation, using minimum 4Degree of freedom. best motor for this type of operation is servo-motors SG90(standard gear) and MG90(metal gear)[2]. For heavy load and long-time operation Metal gear servo motors are the best suitable for this type of task while in my project there is the combination of standard gear and metal gear two category servo which will do the operation standard gear and metal gear[3].

II. Components of Robot

2.1. Servo-motors:-

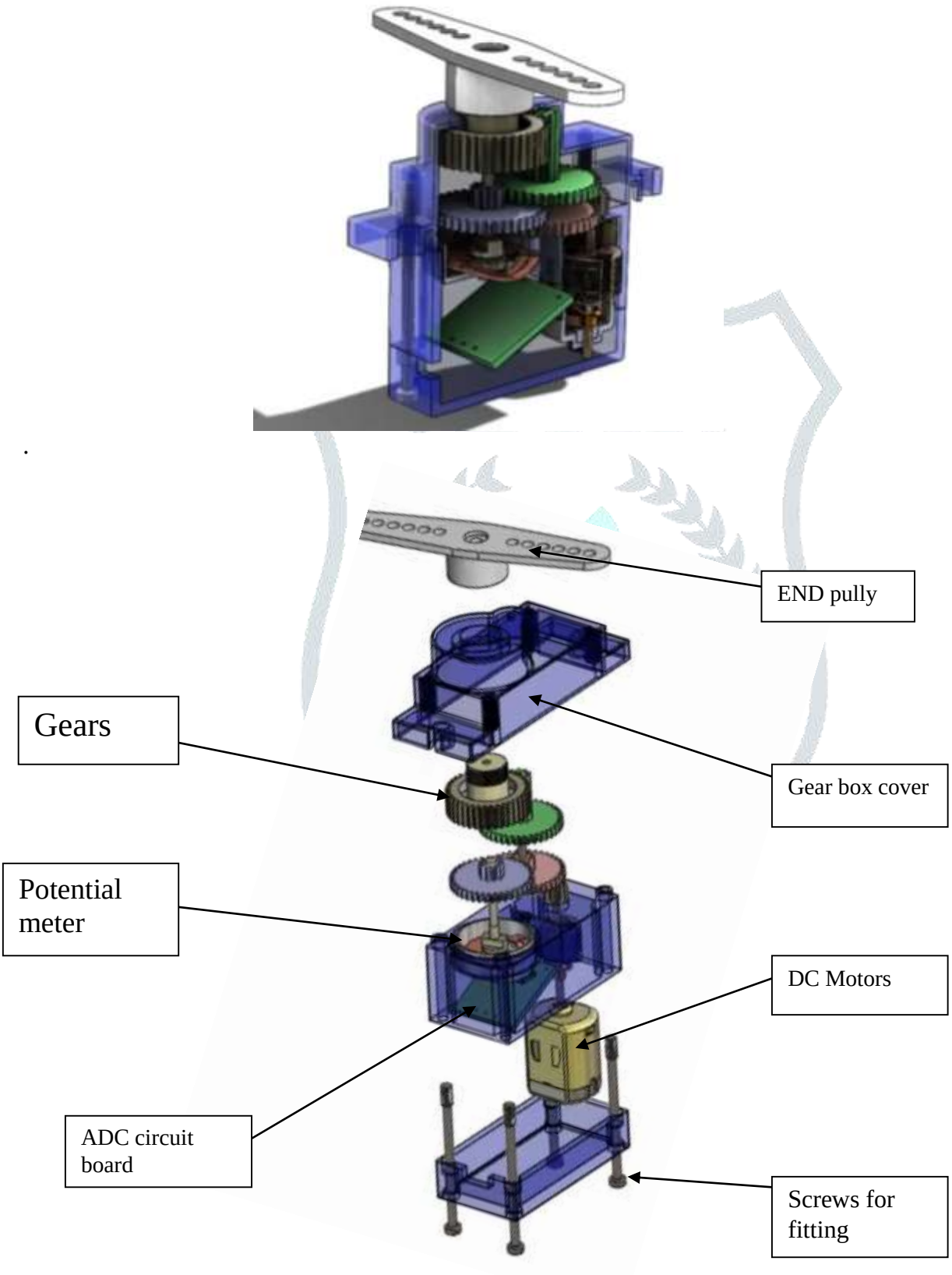

Fig .2. Servo motors and its internal structure

Servo motors is one of the most frequent used motors in the robotics and navigation system where its main working principle is working on feedback mechanism[4]. The potentio meter is directly connected with the

motor shaft and as it rotates in any direction the resistance is varies which gives feedback to controller about the angle of servomotor. The servo-motor is compactable very much with Arduino and it's easier to programme complex programming in budget friendly segment microcontrollers[5].

2.1.2. Working of servo motor:-

They work on the principle of feedback mechanism ad the motor shaft rotates it is coupled with the potentiometer which works as a position sensors for servo motor[6].

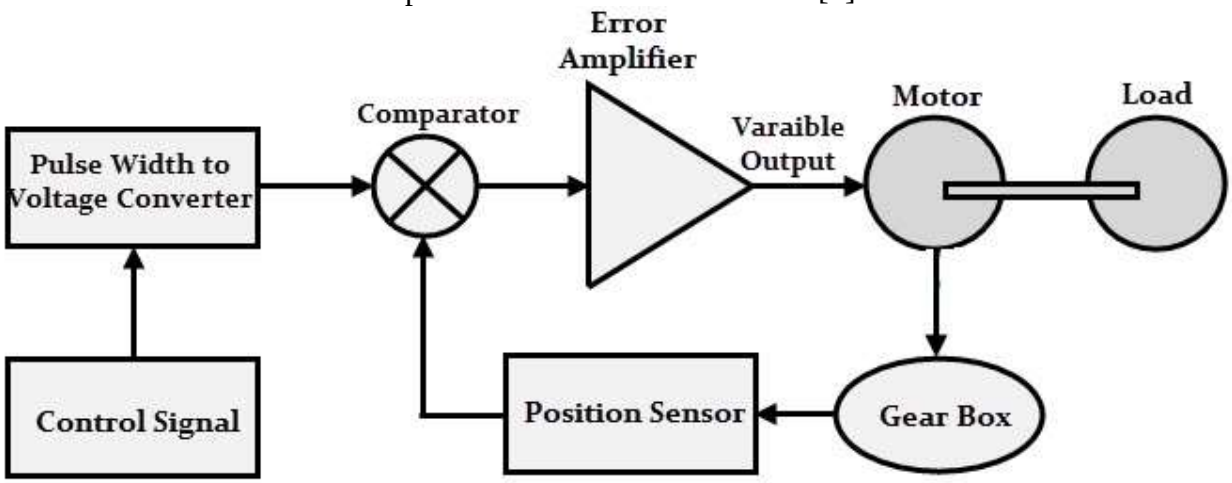

Fig. 3. Working of Servomotor

1- Pulse width Instruction is given to motor to rotate at the same time position sensor sense the position
2- Comparator IC will compare these two input pulse width and position feedback and further transfer to error amplifier.
3- The error amplifier is a negative feedback amplifier and it reduces the difference between its inputs. It compares the voltage related to current position of the motor (obtained by potentiometer) with desired voltage related to desired position of the motor (obtained by pulse width to voltage converter), and produces the error either a positive or negative voltage.
4- Further it gives instruction to motor and motor rotate the shaft up to the angle it's given to rotate.
5- When motor reach its destination angle the position sensor sense its angle and give feedback to comparator and comparator reverse the motor direction so that motor doesn't exceed its position.
6- Further these servomotors also capable to stop at their own position even external force is applied, during external force motor rotates in the reverse direction of force applied by the external bodies hence if the force is acting in clock wise direction then the motor will rotate in anti-clock wise direction to counter the external force and same as if the force is applied in anti-clock wise direction then motor will rotate in clock wise direction and tries to counter the external force and hold on its own place as much as he can[7].

2.2. Arduino Nano:-

Best budget friendly segment microcontroller is arduino-Nano, easily available in market and works on C and C++ language, its architecture is free to download for internet and there are a lot of coding videos available in internet if you face any problem for programing. But for complex coding we need to step up our self for proper executions. Arduino is the best example of combination of software and hardware[8]. Whatever our imagination is there we can build in physical form using this technology. Arduino microcontroller is a 8 bit ATmega328 from AVR family with operating 5V and have 22 I/O pins. Arduino Nano is one type of microcontroller board, and it is designed by Arduino.cc. It can be built with a microcontroller like Atmega328. This microcontroller is also used in Arduino UNO. It is a small size board and also flexible with a wide variety of applications. Other Arduino boards mainly include Arduino Mega, Arduino Pro Mini, Arduino UNO, Arduino YUN, Arduino Lily pad, Arduino Leonardo, and Arduino Due. And other development boards are AVR Development Board, PIC Development Board, Raspberry Pi, Intel Edison, MSP430 Launchpad, and ESP32 board.

About arduino Nano

- ATmega328P Microcontroller is from 8-bit AVR family
- Operating voltage is 5V
- Input voltage (Vin) is 7V to 12V

- Input/output Pins are 22
- analogy i/p pins are 6 from A0 to A5
- Digital pins are 14
- Power consumption is 19 mA
- I/O pins DC Current is 40 mA
- Flash memory is 32 KB
- SRAM is 2 KB
- EEPROM is 1 KB
- CLK speed is 16 MHz
- Weight-7g
- Size of the printed circuit board is 18 X 45mm
- Supports three communications like SPI, IIC, & USART

Fig. 4. Arduino ATmega 328

III- Robotic Arm (4DOF):-

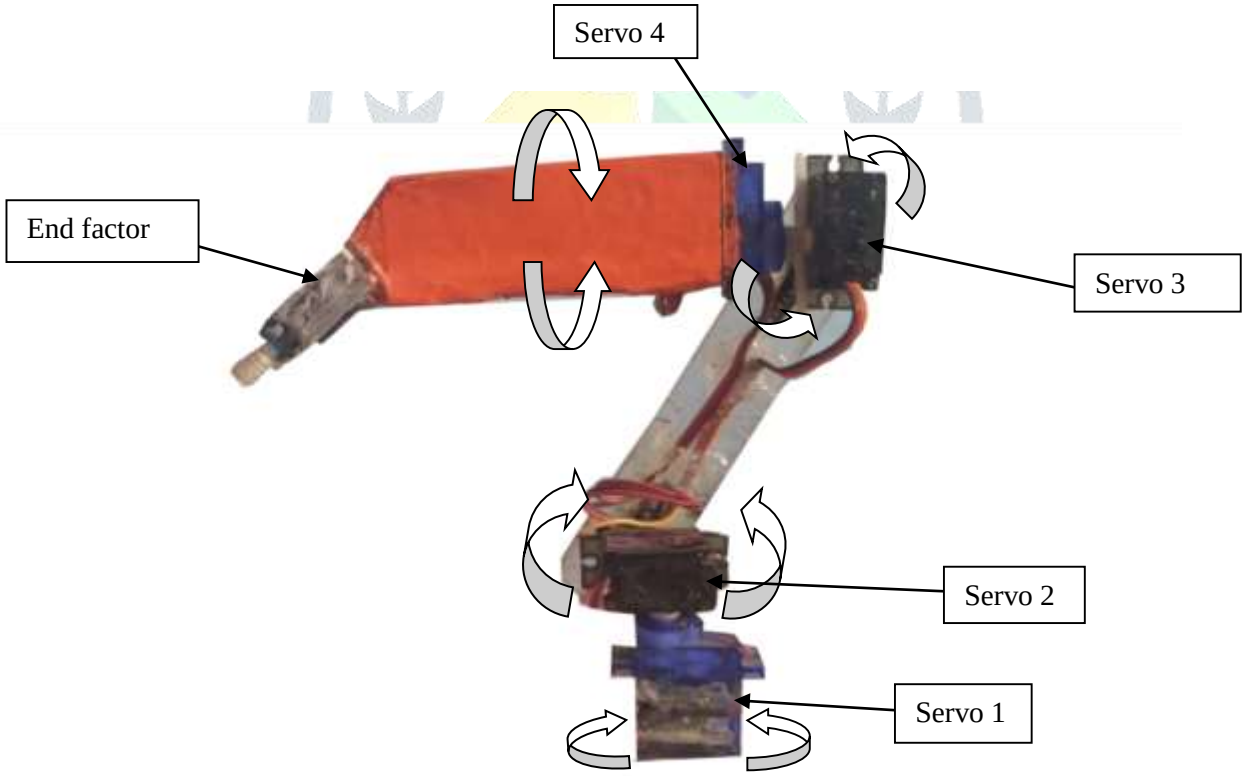

Fig. 5. **Robotic arm (4DOF) used for playing piano**

Servo motor are best motor suitable for robotic arm because they have in-build position sensor and work on feedback mechanism according to given pulse width modulation. In this robot 4 servomotors are used and they all are controlled by the arduino Nano for operation while end factor is hand gripper having stylus touch pen feature to touch the capacitive screen of mobile phone because ordinary gripper cannot be suitable for touch type operation[9].

3.1. Robotic arm assembly parameters

There are 4 servomotors used in his type of operation we need to configure and map the servomotor with arm position according to our requirement.

Servo 1:-

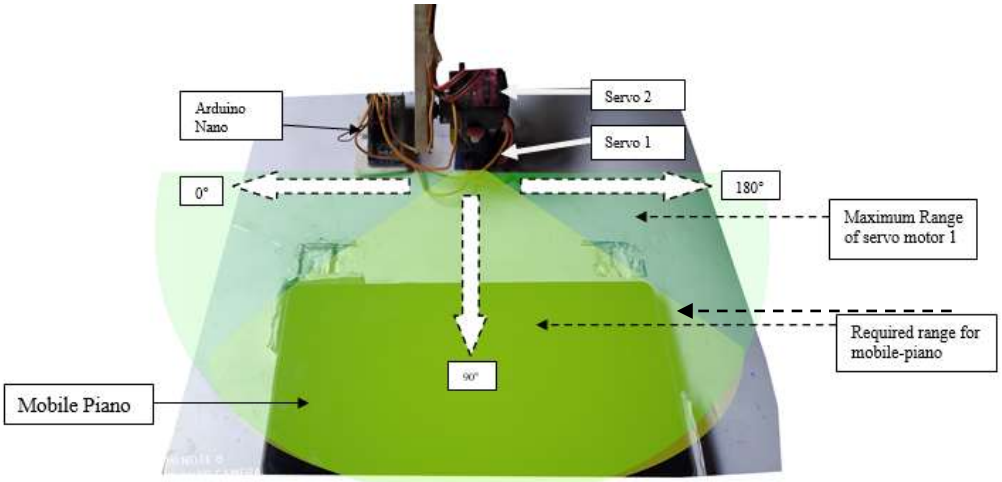

Fig. 6. Top view of Servo-Motor

From the above picture there are two colour shades region are shown on is light green and other is dark colour region.

(i) Light shade region shows the maximum range of robotic arm to reach its end factor which is in semi-circle and covers all the region of mobile phone.
(ii) Dark shade region shows they are required for the operation of playing mobile piano successfully.

While the left side indicates 0° which means if we give zero in command then servo motor will reach its minimum angle, if 90° command given to controller then arm pointes toward the centre of the robot. When 180° then robotic arm reaches the right side and it will be the maximum angle of rotation which a robotic arm can reach. Whatever the piano keys comes in which direction we have to give instruction according to it.

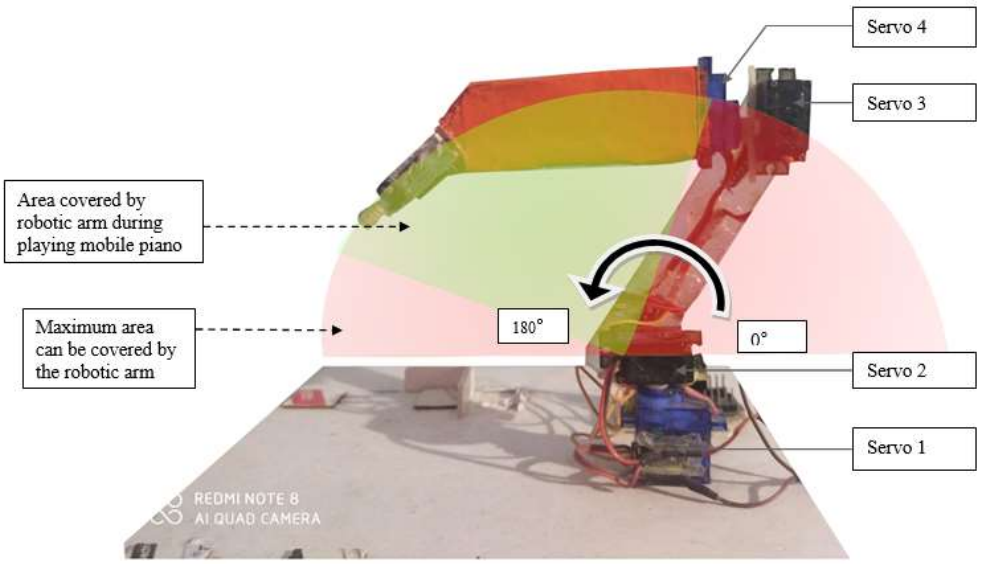

Fig. 7. **Side view of robotic arm**

The above picture shows the area of operation of robotic arm, where the red colour area shows the maximum area can be covered by robotic arm in red semi-circle, where the green area shows the actual area covered by robotic arm during operation of playing mobile piano. The main function played by the servo 1 and servo 2 while servo 3 and servo 4 are used to perform function slightly better and provide more smooth operation for results.

Conclusion:

In this research article, the use of robotics in music industry is discussed. The robotic arm, having 4 degree of freedom is used to play music piano and other instruments. The internal components and working of robotic arm is also discussed along with its computability with Arduino.

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