We are moving towards a future of intelligent robots and Artificial Intelligence. People are developing and designing humanoid robots that can perform specific tasks similar to a human. One day perhaps, we shall have robots capable of blending into society side by side among humans, living and working together.

Music is an essential part of human life and culture. It is a form of expression and personification of emotions. Notes and chords put together form beautiful melodies which can lift one’s mood. We foresee a future where robots can think and play music and make beautiful compositions of their own. That day is not too far away!

Aim
The aim of this project was to build a humanoid robotic arm that can play the piano. We used the lego kit and parts available to us to come up with a design that could efficiently move and play the notes on a piano.

Applications
- Personal musician: To play some beautiful tunes.
- Provide teaching assistance to someone learning to play
  - Play at varying tempo to show the user how a song is played.
  - Play either the bass (left hand) or melody (right hand) while the user plays the other.
Design
The PianoBot was designed using the Lego Mindstorm kit. It consists of six motors which make up the two hands of the robot. The left hand is stationary and comprises of two motors. Each motor controls three fingers which moves together to press a chord. Due to lack of parts, this hand was designed to be stationary and hence, can play only two chords.

The right hand comprises of three motors, each controlling a finger and a fourth motor which controls the horizontal translation of the hand. A strong base was designed to facilitate the fast sideward motion required. Taking the horizontal motion into account, the right hand can span over a total of 6 notes.

The six motors are controlled by two NXT bricks (three each). Which when synchronized together can play some piano melodies with chords. Some images of the design and setup can be seen in Fig 1 and 2 above. Videos of the PianoBot in action can be obtained in the link below.

Technical Challenges
Due to the light weight of the motors and lego pieces, when the fingers “pressed” the piano keys, the backlash would cause the robot to topple. On redesigning the PianoBot, the right
hand had 4 motors and was heavy enough to handle the issue. The left hand was managed by adding some additional counterweight in terms of a heavy book.

The two hands needed to work together to play the song and required to be synchronized. We thought of various possible solutions which included using additional light sensors on each brick which could be used to sense the other brick. However, in the end we realized that this was simply increasing the overhead without providing much benefit in terms of synchronization. We settled for manually starting both bricks as it solved our purpose without much overhead.

**Assessment**

We believe that given the resources at our disposal, we have managed to meet all the requirements we promised in the original proposal. We managed to get fast moving hand and fingers which could play tunes at the desired melody.

However, we were not able to make both hands move the entirety of the piano due to the lack of parts. However, conceptually, that is just an extension of what we built and should work given the parts.

**Video References**

- [https://goo.gl/FVJQjl](https://goo.gl/FVJQjl)