# LESSON 9 ULTRASONIC PROJECT - MUSIC ROBOT

## Lesson Overview

Students will use previous knowledge of Ultrasonic sensor, Buzzer module, and RGB module to create an ultrasonic piano.

## Lesson Target

1. Review the command block to control and use RGB LED, Buzzer, DC Motor, IR, Ultrasonic. Create an ultrasonic Piano.
2. Learn how to use a ruler and understand meaning of distance.
3. Reach out the team spirit through teamwork.

## Lesson Tag

| GRADE LEVEL | SUBJECTS | DIFFICULTY | DURATION | GROUP |
|---|---|---|---|---|
| Elementary, middle | STEAM, computer science | Beginner | 2 x 50 mins | 4-5 students |

## Supplies

| Robot | Accessories | Other Material | Tools Used |
|---|---|---|---|
| WeeeBot Kit | USB cable | PC with WeeeCode software; USB port required; Paper; tape | Pen; Ruler |

## Lesson Outline

INTRO: Review the command block to control and use RGB LED, Buzzer, DC Motor, IR, Ultrasonic.

Review how to draw a flow diagram.

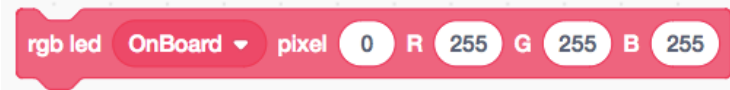CREATE: Students program and create an ultrasonic piano.
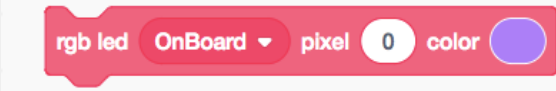
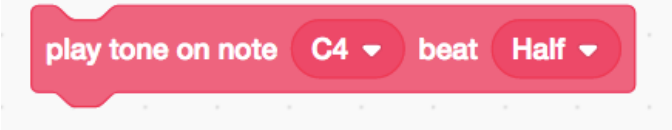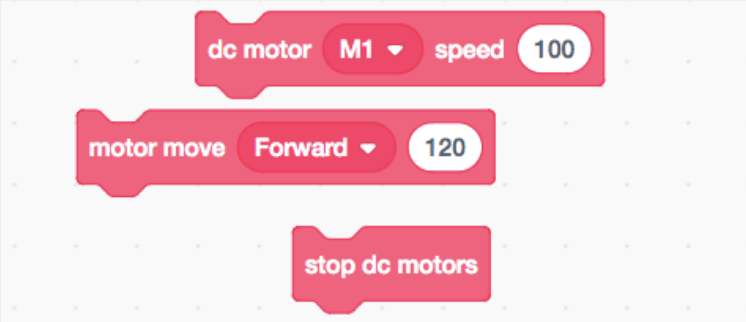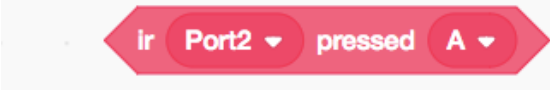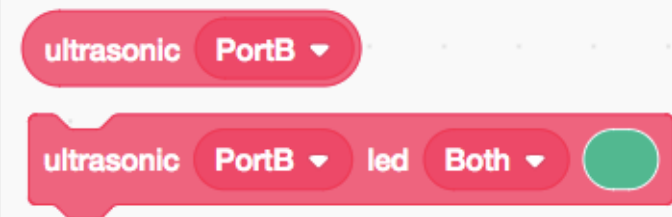PLAY: Each group tests, then records learnings from their invention. Students explore how their invention works, plus the coding concepts behind it.

REMIX: Students will customize and enhance their inventions to create a song through opportunities to change the circuit, code, and the game play.

**Routine**

## 1. REVIEW

**Review the coding blocks to control hardware**

| Hardware | WeeeCode Blocks | Instruction |
|---|---|---|
| RGB LED | rgb led OnBoard ▾ pixel 0 R 255 G 255 B 255 | Select RGB LED port (or onboard) ->select pixel (0 for one pixel) ->change value of Red, Green, Blue to get different color. |
| | rgb led OnBoard ▾ pixel 0 color ⬤ | Select RGB LED port (or onboard) ->select pixel (0 for one pixel) ->Select color |
| Buzzer | play tone on note C4 ▾ beat Half ▾ | Control the note and beat of buzzer's sound. C~B refers to do~si; 3~5 refers to different tone range; |
| DC Motor | dc motor M1 ▾ speed 100 <br> motor move Forward ▾ 120 <br> stop dc motors | 1. Control one motor's speed and rotation direction; <br> 2. Control both motor. <br> 3. Stop all motors. |
| IR | ir Port2 ▾ pressed A ▾ | Working together with case structure. |
| RGB Ultrasonic Sensor | ultrasonic PortB ▾ <br> ultrasonic PortB ▾ led Both ▾ ⬤ | 1. Select the port of ultrasonic sensor. This code will get the distance value from ultrasonic sensor, unit is cm. <br> 2. Control the color of RGB LED. |

**Review the program flow chart**

Program flow chart is a description of the algorithm, workflow, or process of solving problem. It uses various kinds of boxes and flow lines to representing different steps and orders. Before designing a program or solving a problem, we can use flow chart to help visualize what to do and thereby help get a solution to a given problem.

Program flow chart has below kinds of symbols:

: this is the start/end box, representing the start or the end of program.

: this is the activity box, representing the processing step.

: this is input/output box.

: this is flow line, representing the order of executing.

## 2. TASK AND ASSIGNMENT

**Task**

Requirements:

a) Buzzer must make different sound per the different value read by ultrasonic sensor. Each sound should have its own color on RGB LED. When sound changes, color changes.

b) Draw a program flow chart to get a solution for the task, and then make programs accordingly.

c) Draw the piano keyboard on paper: different key makes different note and different color.

d) Play a song with the robot.

**Assignment**

Every team should assign work for each member in the team, and explain the reason why make such an assignment. Fill in below chart.

| Name | Task | Why | Estimate Time Cost | Actual Time Cost |
|------|------|-----|--------------------|------------------|
| **Jane** | Draw program flow chart | Carefully, good at logic | 10 mins | |
| **David** | | | | |
| **Alice** | | | | |
| **Jack** | | | | |

Tips:

1. Suggest 4-5 students as a team.

2. Lead students make assignment per everyone's gift; lead students use time properly。

3. Fill in the actual time cost after work finished.

## 3. CODING

Draw program flow chart for the ultrasonic piano.

```
                    ┌─────────┐
                    │  Start  │
                    └─────────┘
                         │
                         ▼
                   ╱ Ultrasonic ╲        YES
          ┌───────  value 4-7    ──────────────┐
          │        ╲           ╱                ▼
          │             │                ┌──────────────────────┐
          │             NO               │ Play C4, RGB turn Red │
          │             ▼                └──────────────────────┘
          │       ╱ Ultrasonic ╲        YES
          │─────── value 7-10   ──────────────┐
          │        ╲           ╱               ▼
          │             │              ┌─────────────────────────┐
          │             NO             │ Play D4, RGB turn Orange │
          │             ▼              └─────────────────────────┘
          │       ╱ Ultrasonic ╲        YES
          │─────── value 10-13  ──────────────┐
          │        ╲           ╱               ▼
          │             │              ┌─────────────────────────┐
          │             NO             │ Play E4, RGB turn Yellow │
          │             ▼              └─────────────────────────┘
          │       ╱ Ultrasonic ╲        YES
          │─────── value 13-16  ──────────────┐
          │        ╲           ╱               ▼
          │             │              ┌────────────────────────┐
          │             NO             │ Play F4, RGB turn Green │
          │             ▼              └────────────────────────┘
          │       ╱ Ultrasonic ╲        YES
          │─────── value 16-19  ──────────────┐
          │        ╲           ╱               ▼
          │             │              ┌───────────────────────┐
          │             NO             │ Play G4, RGB turn Blue │
          │             ▼              └───────────────────────┘
          │       ╱ Ultrasonic ╲        YES
          │─────── value 19-22  ──────────────┐
          │        ╲           ╱               ▼
          │             │              ┌─────────────────────────┐
          │             NO             │ Play A4, RGB turn Indigo │
          │             ▼              └─────────────────────────┘
          │       ╱ Ultrasonic ╲        YES
          │─────── value 22-25  ──────────────┐
          │        ╲           ╱               ▼
          │             │              ┌─────────────────────────┐
          │             NO             │ Play B4, RGB turn Violet │
          │             ▼              └─────────────────────────┘
          └─────────────┘
```
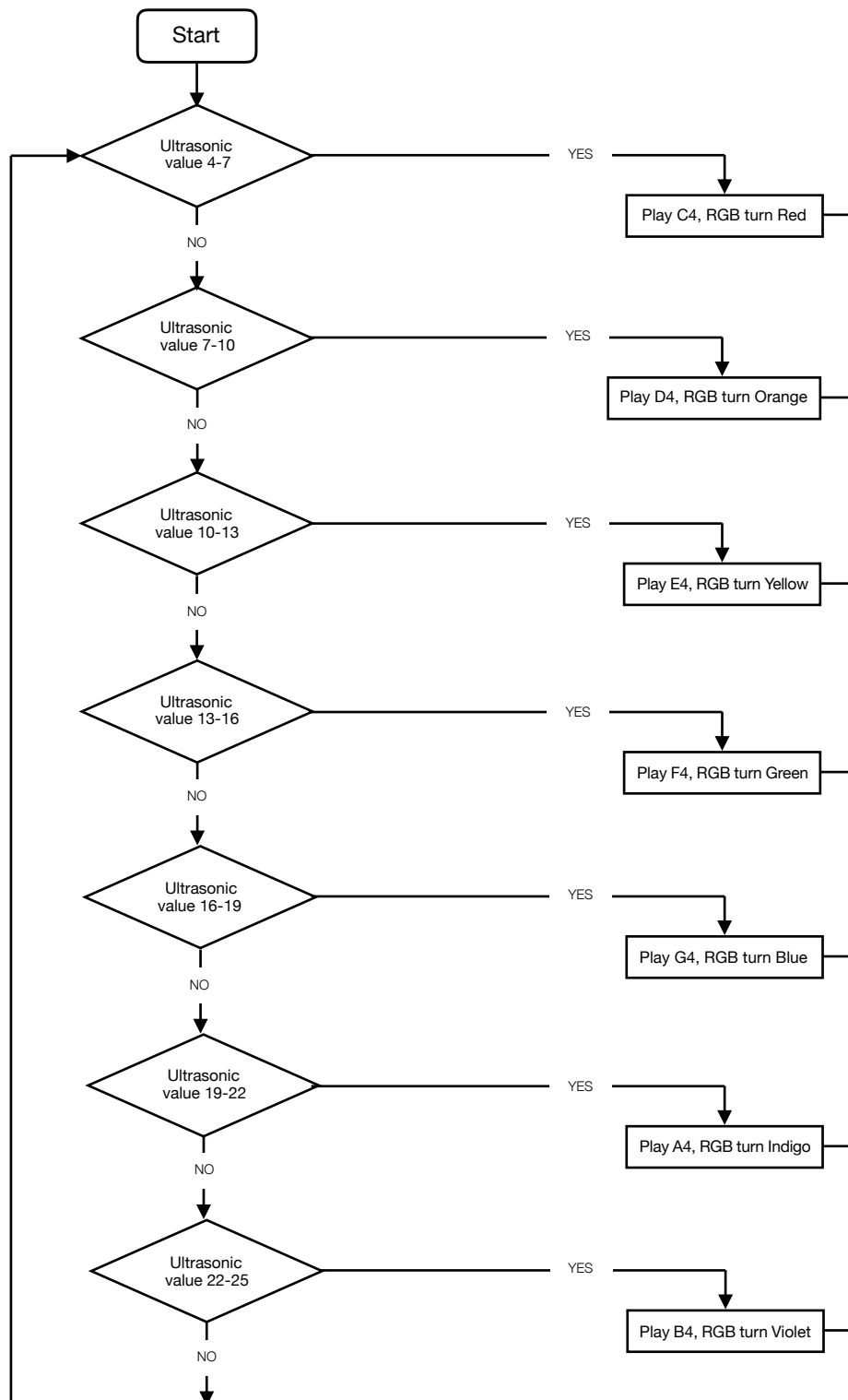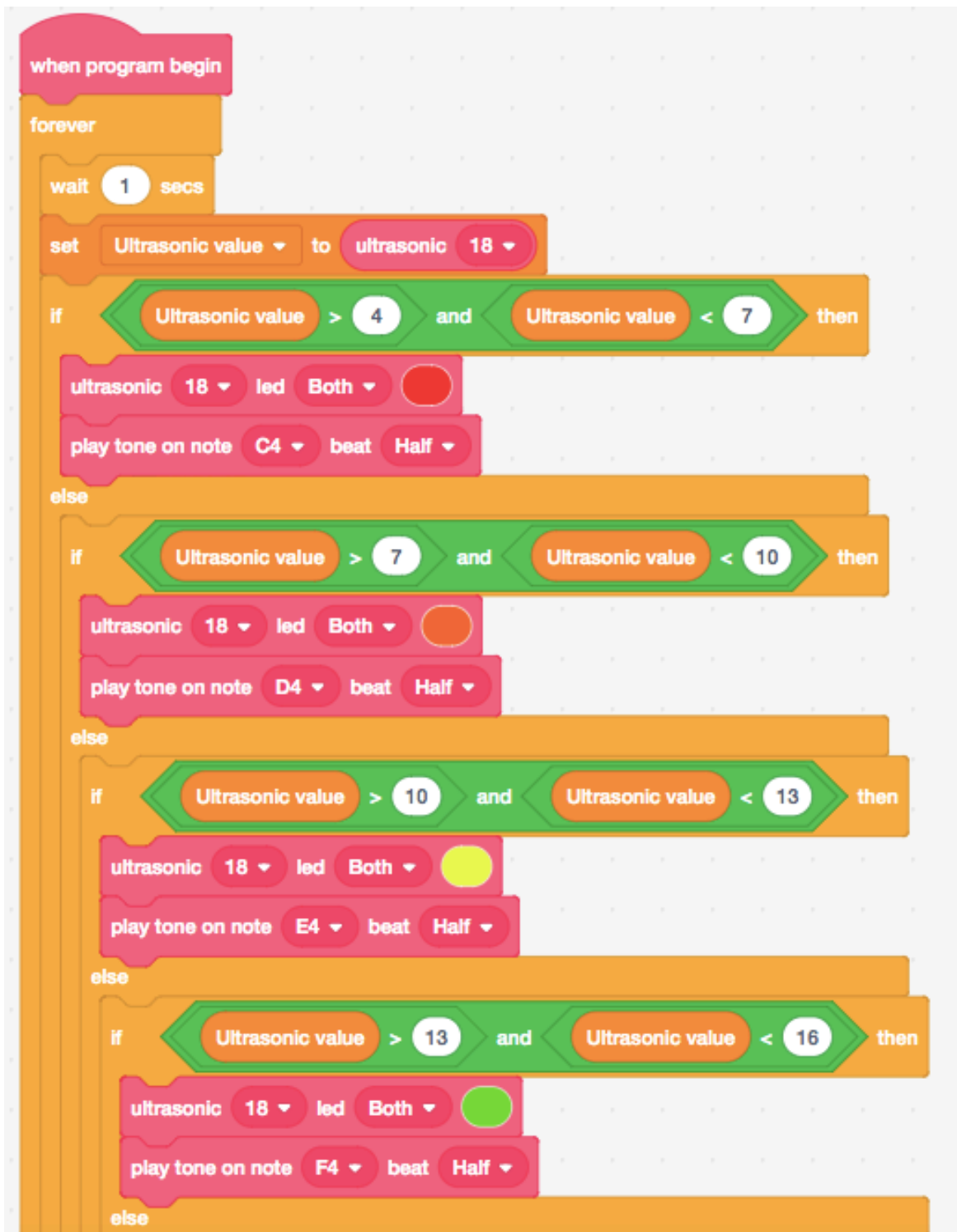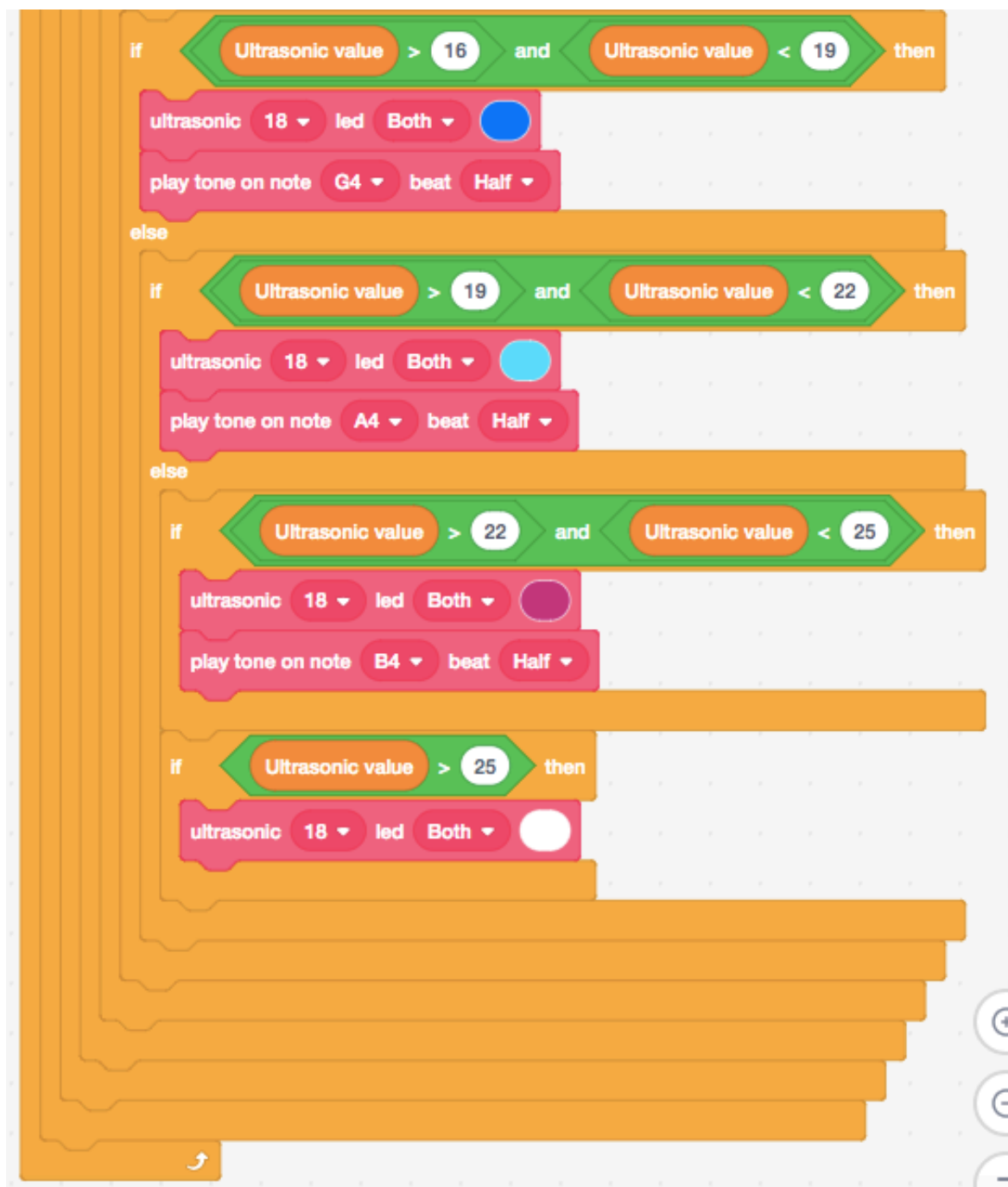
Tips: The range of ultrasonic value, referred color and music note can be defined by students.

```
when program begin
forever
  wait 1 secs
  set Ultrasonic value ▼ to ultrasonic 18 ▼
  if Ultrasonic value > 4 and Ultrasonic value < 7 then
    ultrasonic 18 ▼ led Both ▼ ●
    play tone on note C4 ▼ beat Half ▼
  else
    if Ultrasonic value > 7 and Ultrasonic value < 10 then
      ultrasonic 18 ▼ led Both ▼ ●
      play tone on note D4 ▼ beat Half ▼
    else
      if Ultrasonic value > 10 and Ultrasonic value < 13 then
        ultrasonic 18 ▼ led Both ▼ ●
        play tone on note E4 ▼ beat Half ▼
      else
        if Ultrasonic value > 13 and Ultrasonic value < 16 then
          ultrasonic 18 ▼ led Both ▼ ●
          play tone on note F4 ▼ beat Half ▼
        else
```
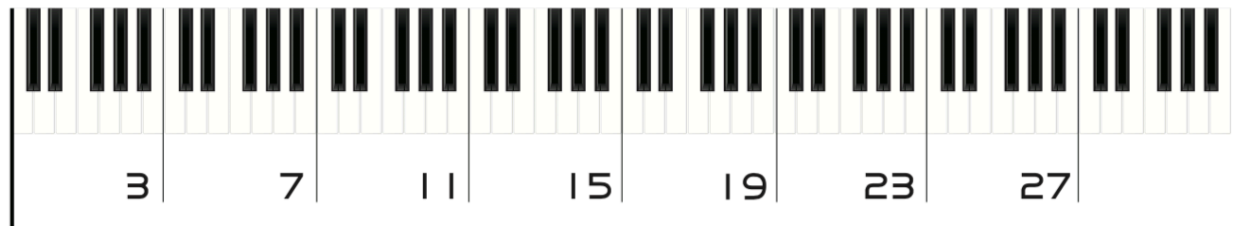
Tips:

a)   Students can select beat they prefer for buzzer.

b)   In the beginning, "Wait 1 secs" is required. Or ultrasonic sensor will detect distance with nonstop.

c)   The last code structure use decision structure "if…then…". If the value is not true, play no tone.

**Draw the piano key zone**

Tips: those samples are only for reference. Students can design their own piano key zone.

## 4. PLAY AND REMIX

I.   Each team use the ultrasonic piano robot they create to play a song. Score for the performance between teams.

II.  Ask students share the process of assigning works in team.



Measure Line