

LOKII-CE BOARDS

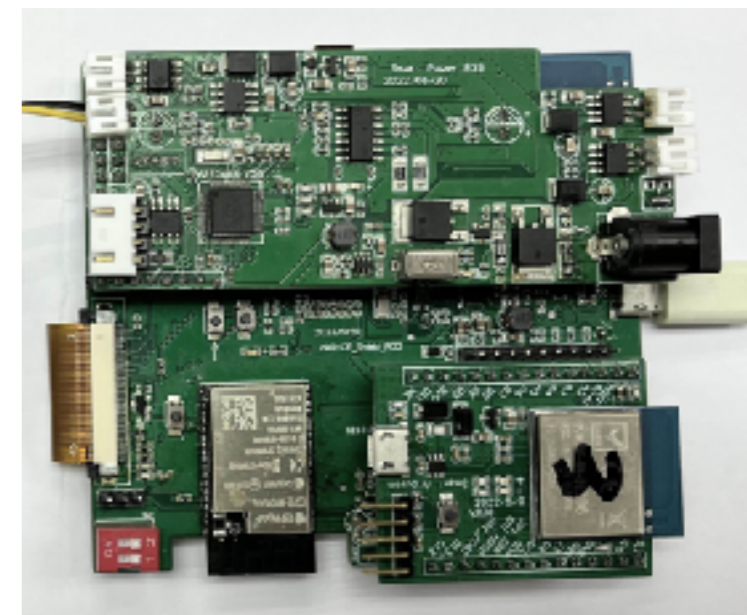
*FOR STEM, PROTOTYPING,
PRODUCTIZATION*

2023

Centek International (HK) Ltd.

LOKII-CE BOARDS

- LOKII-CE come from
 - **LOKII** : **L**ow cost **O**perating System with **K**nowhow and **I**nnovation **I**ntelligent
 - **CE**: **C**loud-Enabled AI Features
- LOKII-CE boards is an **Arduino ready platform** which supports **Arduino programming** and also **Graphical Blockly IDE** with embedded functions:
 1. Image processing functions (color blob detection, face detection, etc)
 2. Speech Recognition
 3. Text-to-Speech
 4. Control Smart devices (sensors + motors) using a single bus topology.
 5. Wireless SmartIOT connectivity and AI Cloud computing
(2nd phase roadmap)

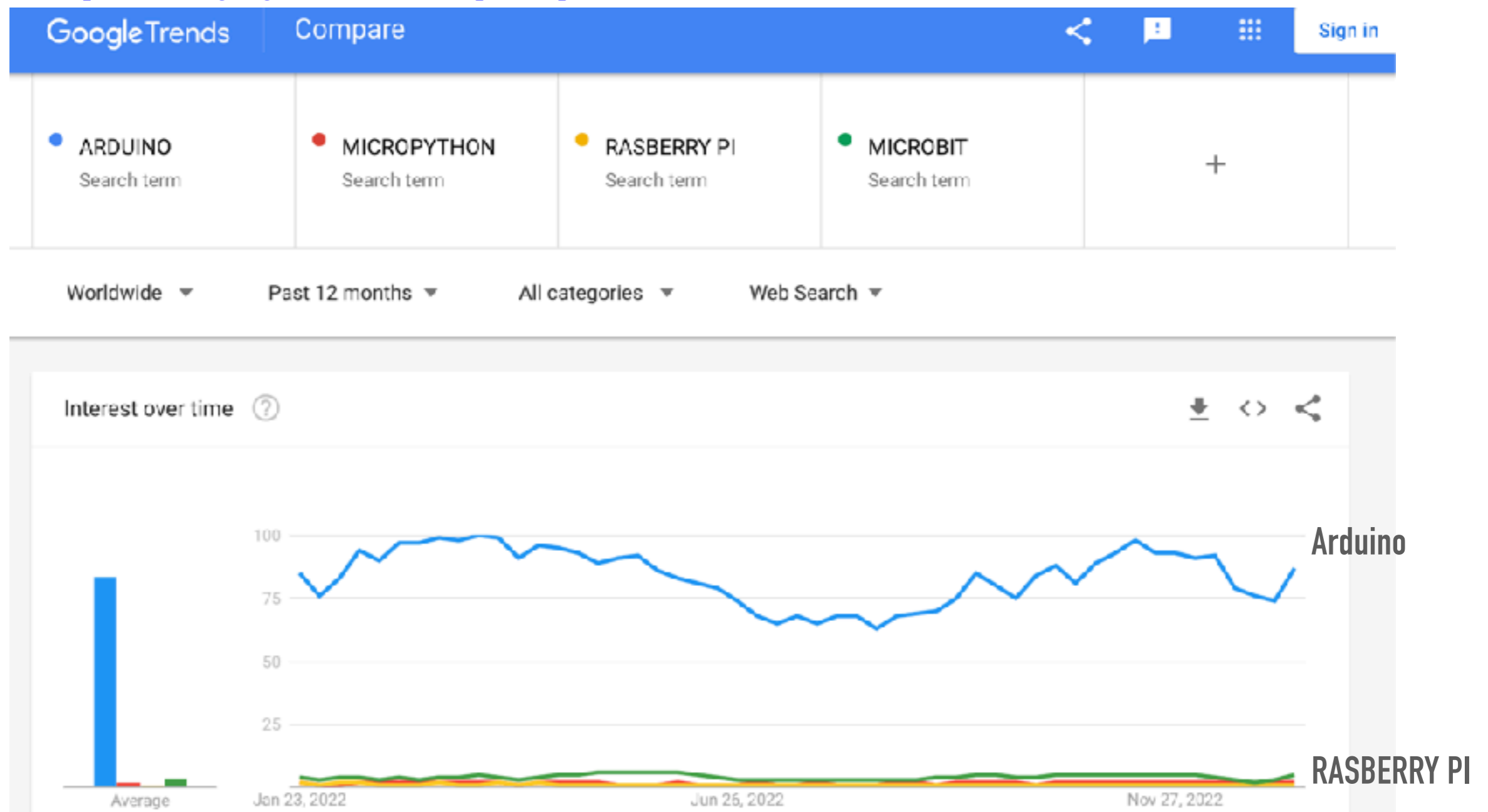


DEVELOPMENT BOARDS COMPARISON

WHY WORK WITH ARDUINO?

- According to Google Trend, Arduino dominates the market.
(Its target audience coming from students to working engineers)

<https://trends.google.com/trends/explore?q=ARDUINO,MICROPYTHON,RASBERRY%20PI,MICROBIT>



COMPARISON FOR BOARDS (OVERVIEW)

	ARDUINO	RASBERRY PI
Hardware	<ul style="list-style-type: none">• A Microcontroller board (8-bit to 32-bit MCU option, from Atmel/Microchip)• Many Arduino-Shield board to extend hardware function• Low power consumption	<ul style="list-style-type: none">• A Microcomputer• (64-bit Powerful MCU – only from BroadCom BCM2xxxx series) Limited HAT boards to extend hardware function• High power consumption (Just like an android device)
Software	<ul style="list-style-type: none">• Non-OS or Realtime RTOS system• Boot up instantly• Support realtime hardware control	<ul style="list-style-type: none">• Armbian Linux Operating system• Boot up time can be ~30 seconds• Realtime hardware control is not guaranteed
Programming language	<ul style="list-style-type: none">• Arduino IDE (C /C++)	<ul style="list-style-type: none">• Any programming tools, but you need to have sufficient computer knowledge
Set up complexity	Install an Arduino IDE and then programming (15 minutes?)	Install a raspberry Pi operating system , install programming environment and dependency (1 – 3 hours)

COMPARISON FOR BOARDS (PRODUCTIZATION)

	ARDUINO	RASBERRY PI
Hardware design	<ul style="list-style-type: none">• Open• (Arduino board Circuit / Hardware BOM can be downloaded in internet)	<ul style="list-style-type: none">• Close• (Partial circuit with proprietary hardware components, such as Broadcom BCM2xxx MCU)
Software License	<ul style="list-style-type: none">• Software license (hardware control) are almost free for commercial use.	<ul style="list-style-type: none">• Software license are complicated: BSD / GPL/ MIT /commerical , etc.... because it is a computer which allow you to install anythings...
Costing	<ul style="list-style-type: none">• Easy• All hardwares are open BOM	<ul style="list-style-type: none">• Difficult• MCU: Broadcom BCM2xxx MCU is not easily market purchasable<ul style="list-style-type: none">• https://forums.raspberrypi.com/viewtopic.php?t=308875• Whole rasberry PI board – No mass volume bulk purchase option
Mass Production feasible?	YES	NO

COMPARISON FOR BOARDS (SUMMARY)

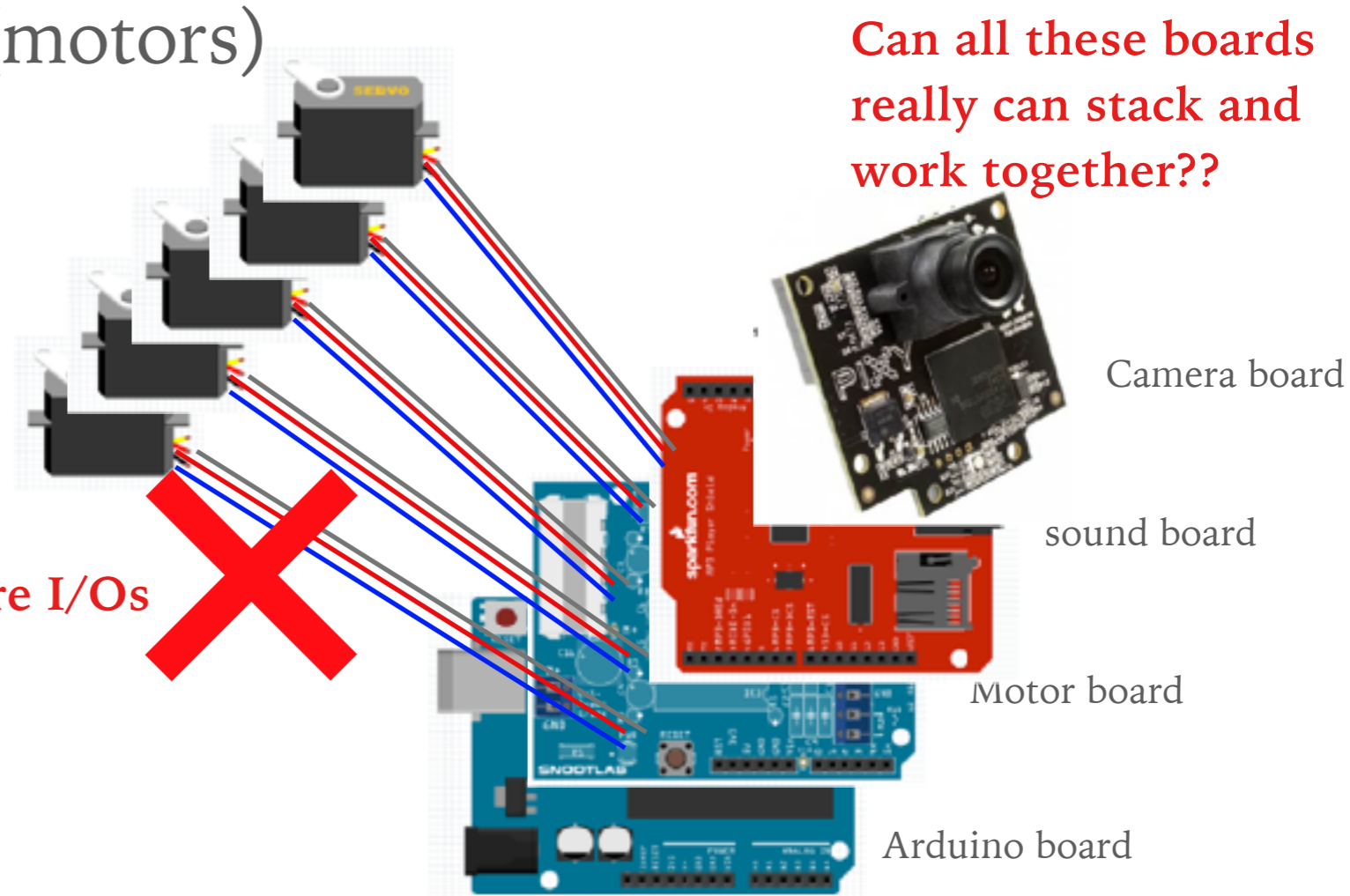
	ARDUINO	RASBERRY PI
Target Audience	<ul style="list-style-type: none">• Electronic / embedded software engineer• Developer with clear hardware requirements• Product inventor wants to compute production cost / evaluate hardware performance.• STEM students	<ul style="list-style-type: none">• Computer programmer• Developer targets for software simulation and function demonstration• Product inventor wants to proof of concept• STEM students with assistance from teachers for setup

**LOKII-CE SOLUTION FOR
CURRENT ARDUINO DEVELOPMENT**

WHAT IS CURRENT ARDUINO PROBLEM?

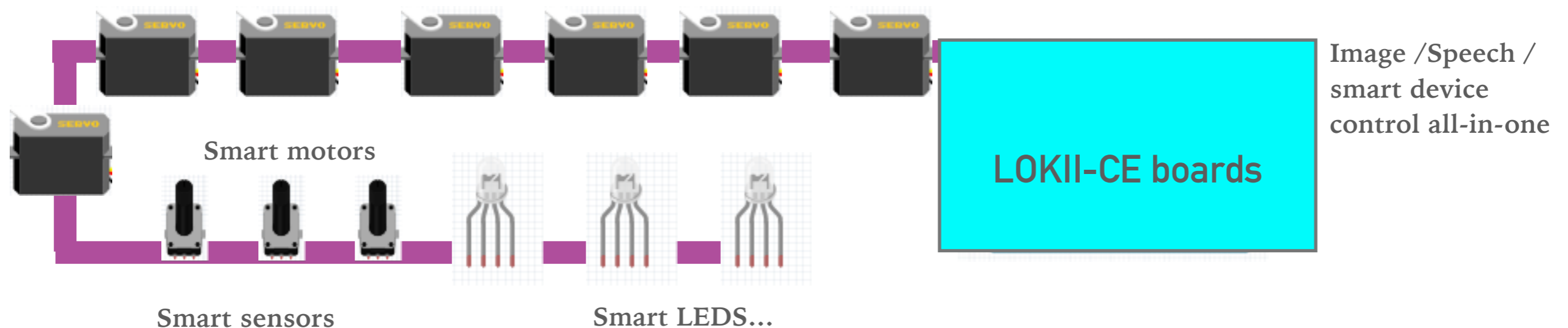
- Arduino Ecosystem is diverse and focus on digital signals
 - There is no single board solution for (sound/image/motor control), and even AI functions...
- These boards may not compatible with each other
- Number of peripherals (motors) are limited by I/Os..
- This limits Markers and students' creativities

Sorry, No more I/Os for additional motors



LOKII-CE SOLUTION

- LOKII-CE provides a total solution for AI functions and robot makers
- Our single board can do image processing/Text-to-Speech and Smart device controls (motors and sensors)
- Single bus for all LOKII-CE smart devices (SMART_DEVICES)

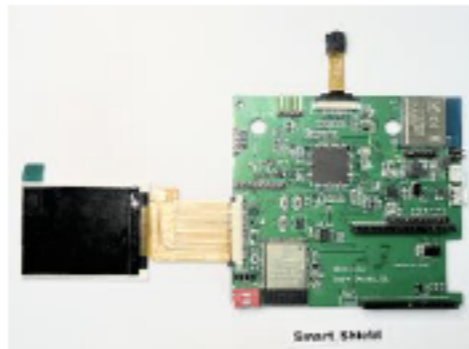


LOKII-CE SOLUTION

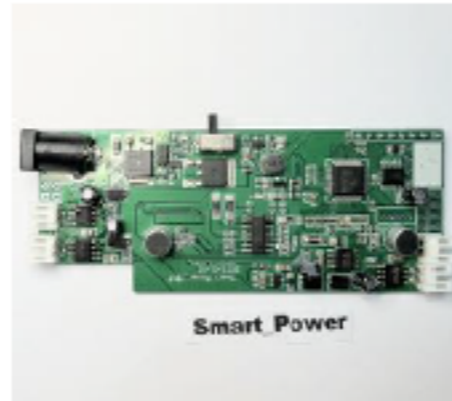
- LOKII-CE boards are targeted for mass production.
 - Every components are market available and configurable.
 - Every built-in software license are configurable.
- Centek provides services to evaluate the product cost based on the LOKII-CE prototyping functions.

	ARDUINO	LOKII-CE boards
Hardware Equivalent	<ul style="list-style-type: none">• Arduino Nano BLE board• Arduino YUN WIFI board• DSP Arduino Shield• Camera shield board• LCD shield board• Arduino Motor Shield Rev3	<ul style="list-style-type: none">• SMART_SHIELD• SMART_POWER• SMART_ARDUINO
Device control	limited to the hardware connection PIN.	support up to 200 external device controls through SMART_BUS
Cost	> USD \$200	< USD \$100

LOKII-CE HARDWARE



SMART_SHIELD



SMART_POWER



SMART_ARDUINO



**SMART_SHIELD , SMART_POWER,SMART_ARDUINO
(LOKII-CE board) can stacked together to provide Arduino
programming functions**

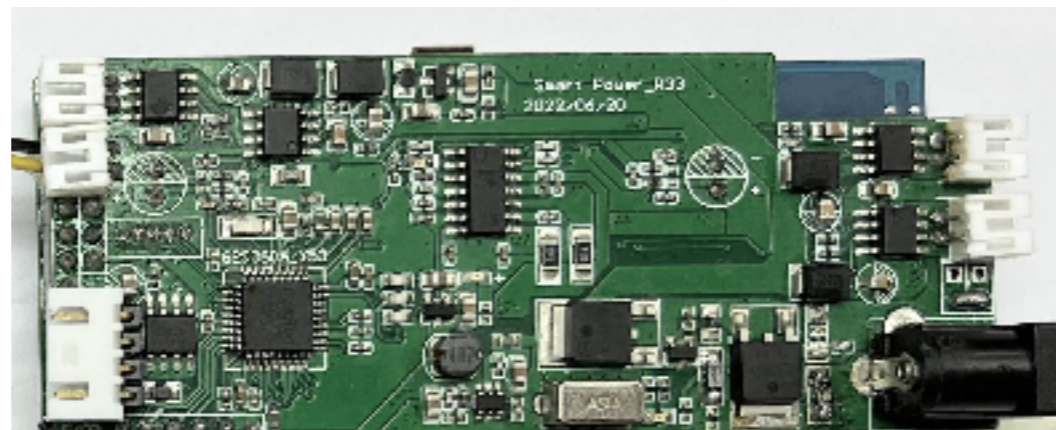
SMART_ARDUINO

- A board with Cortex-M4 MCU and bluetooth 5.0 wireless module to allow user to program LOKII-CE functions through Arduino IDE.



SMART_POWER

- A board aims to drive and deliver power to all SMART_DEVICES attached in its SMART_BUS.
- This board accepts 6-9V DC input and provide up to ~40W power to SMART_BUS
- In addition, it has 4 spare DC motor ports.



SMART_SHIELD

- An ARM9 multimedia MCU + WIFI + Bluetooth + LCD + Camera + Microphone board which includes commercial licensed software library for AI functions, including:
 - Image processing
 - Sound processing
 - Multimedia processing
 - SMART_DEVICE control algorithm
 - Wireless control functions



LOKII-CE IMAGE PROCESSING FEATURES

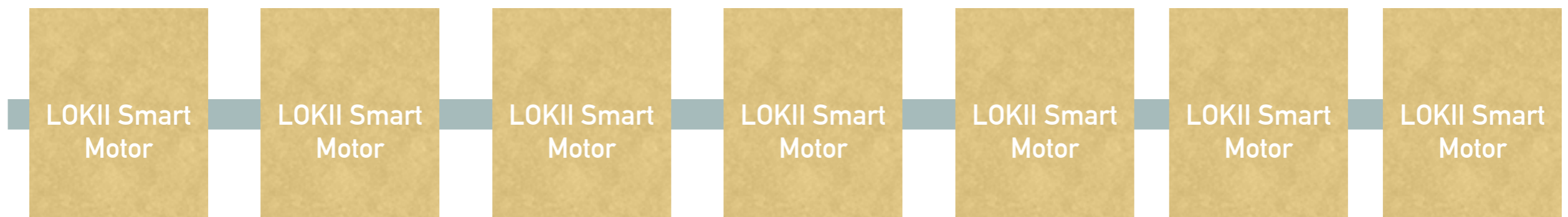
- LOKII-CE supports:
 - Red/Green/Blue/Custom color object detection in 30 fps
 - Single Face detection in realtime
 - JPEG photo taking from built-in camera
 - JPEG playback on built-in LCD Screen
 - H.264 video taking from built-in camera
 - H.264 video playback on built-in LCD Screen

LOKII-CE SOUND PROCESSING FEATURES

- LOKII supports:
 - Speaker Independent Keyword dictation with built-in keyword sets:
 - "Number group" ==> ["0", "1", "2", "3", "4", "5", "6", "7", "8", "9", "10"]
 - "Action group" ==> ["Action", "Move", "Turn", "Run", "Look", "Attack", "Stop", "Hello"]
 - "Movement group" ==> ["Turn Left", "Turn Right", "Move Up", "Move Down", "Go"]
 - Speaker dependent Keyword training and recognition
 - Realtime Text-to-Speech function with Emotion/Speed/Pitch control
 - Wav/MP3 music playback from internal storage
 - Music note playback

LOKII-CE SMART_DEVICE CONTROL

- All LOKII smart devices are shared and connected by a single bus (4-wires SMART_BUS) for communication and power supply.
- SMART_BUS is adequate to support up to 200 smart devices for communication.
- Every smart device has a unique and configurable identifier.



LOKII-CE SMART_DEVICE

➤ LOKII-CE currently has released two SMART device boards:

1) SMART DC motor control board

- Support 4 x DC motors
- Suitable for wheel control

2) SMART RC servo control board

- Support 4 x RC servo motors
- Suitable for robotic arm movement control



LOKII-CE HARDWARE

LOKII-CE SOFTWARE

LOKII-CE ARDUINO PROGRAMMING (ADVANCE MODE)

- LOKII-CE provides Arduino libraries for maker to program in C /C++ language through SMART_ARDUINO interface.

```
//Init LOKII here
void connect();

// LOKII camera states
void setCameraMode( int cameraState );
// register custom color
void registerColor();

int getFaceResult(int attributeType );
int getBlobCount( );
int getBlobResult( int blobIndex, int attributeType );

void startSpeechRecognize( int wordgroupIndex);
int getSpeechResult( );

// Speech and sound methods
void setVolume(int vol);
void playTTS( String text, int voiceType, int speed, int pitch , int emotion);
void playSoundFile( String );
void stopSound();

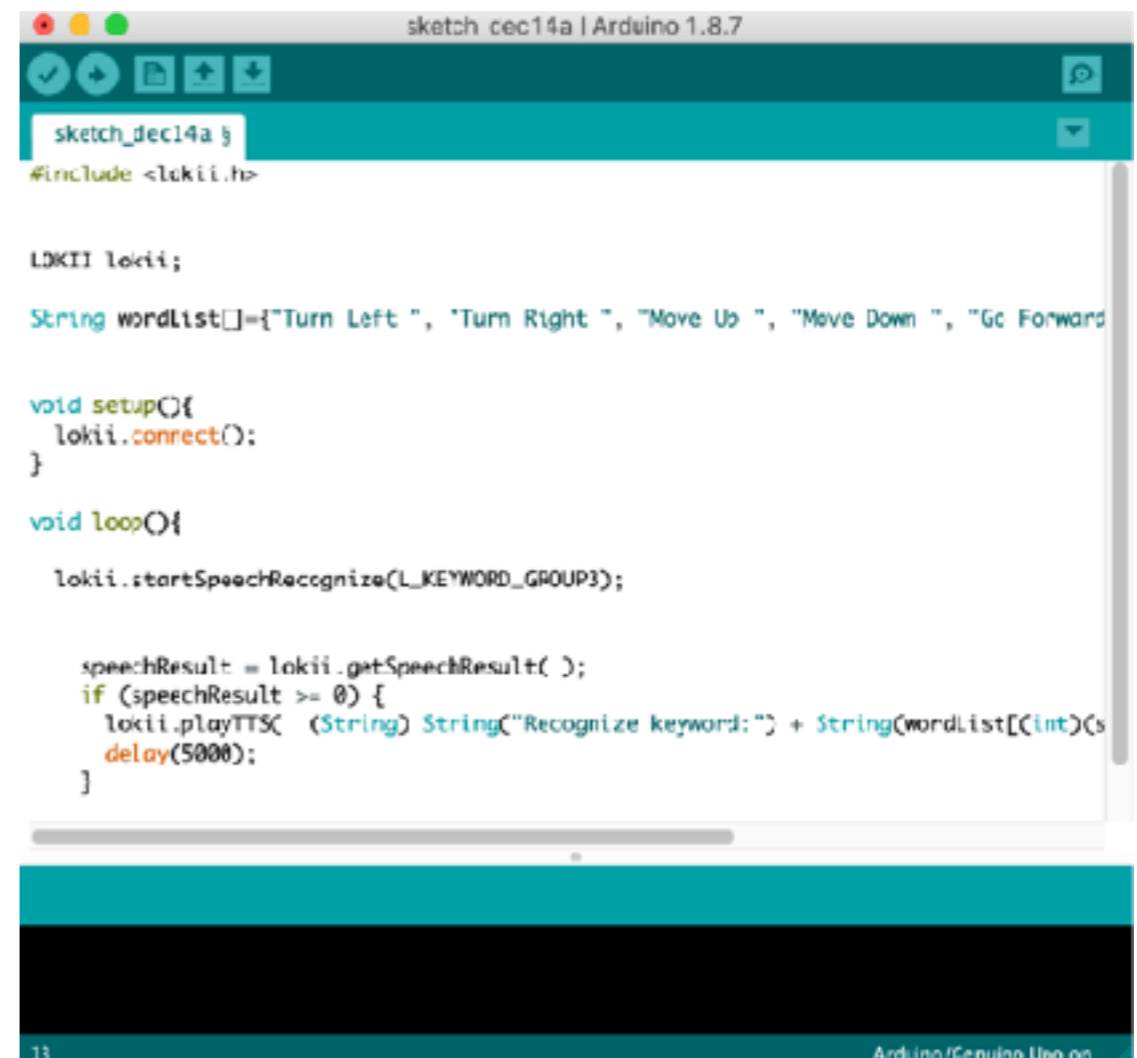
int checkAudioStatus( );

// Motor functions , position = 0xFFFF for endless movement
void moveMotor( int motorid, int speed, int position , int direction );
int readMotorStatus(int motorid);

void setSmartDeviceAdress(int id);
void playbackMotor();

void recordMotor(int numSeconds);

void setRGB(int motorid, int r, int g, int b);
```



```
sketch cec14a | Arduino 1.8.7
sketch_dec14a
#include <lokii.h>

LOKII lokii;

String wordList[]={"Turn Left ", "Turn Right ", "Move Up ", "Move Down ", "Go Forward

void setup(){
  lokii.connect();
}

void loop(){

  lokii.startSpeechRecognize(L_KEYWORD_GROUP3);

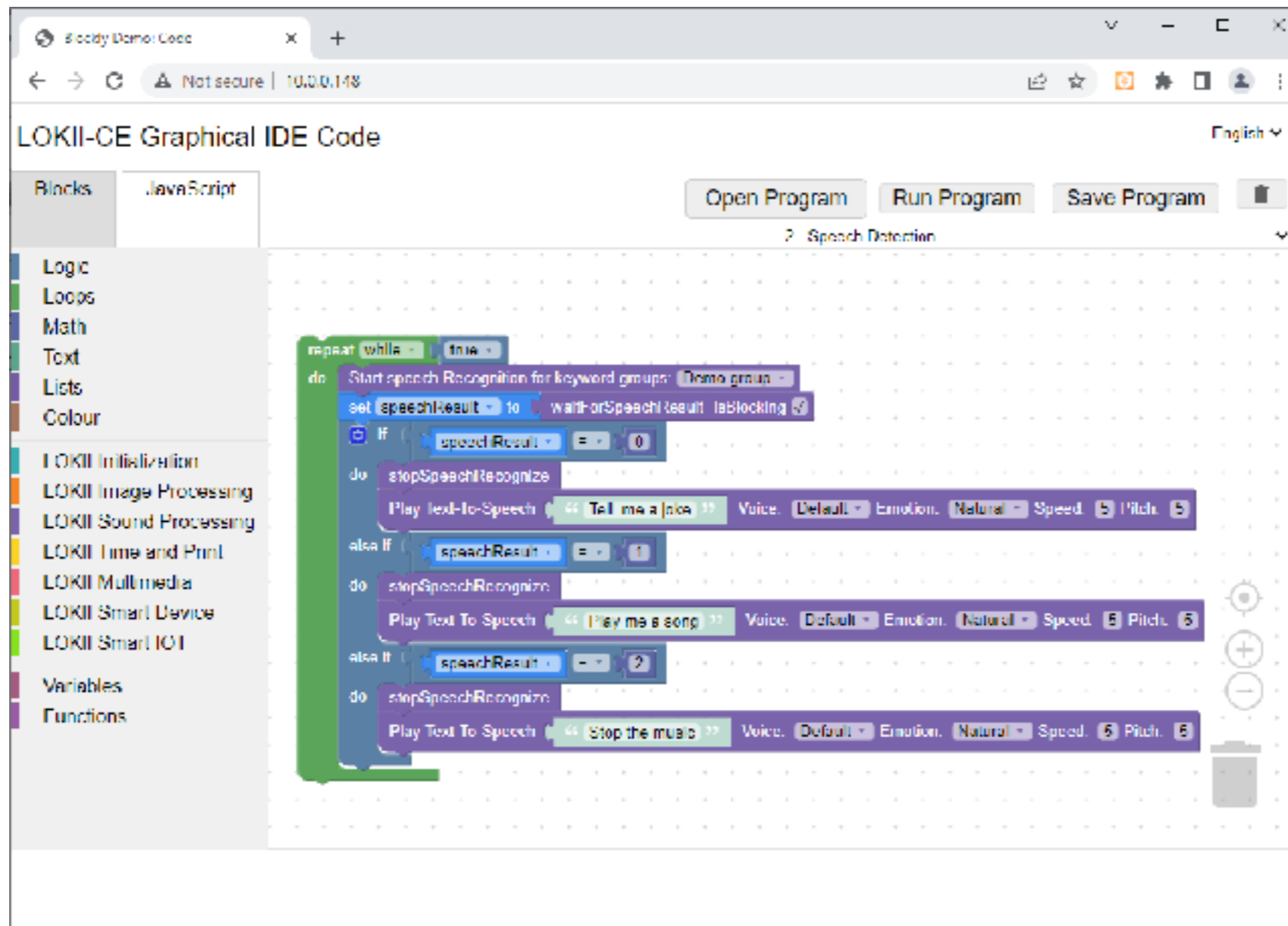
  speechResult = lokii.getSpeechResult( );
  if (speechResult >= 0) {
    lokii.playTTS( (String) String("Recognize keyword:") + String(wordList[(int)Cs
    delay(5000);
  }

Arduino/Genuino Uno on
```



LOKII-CE GRAPHICAL PROGRAMMING (SIMPLE MODE)

- LOKII-CE provides Blockly interface to allow teenagers to program in drag and drop environment through Internet Browser.
- (Support Window /Mac /iPad/Android tablet)



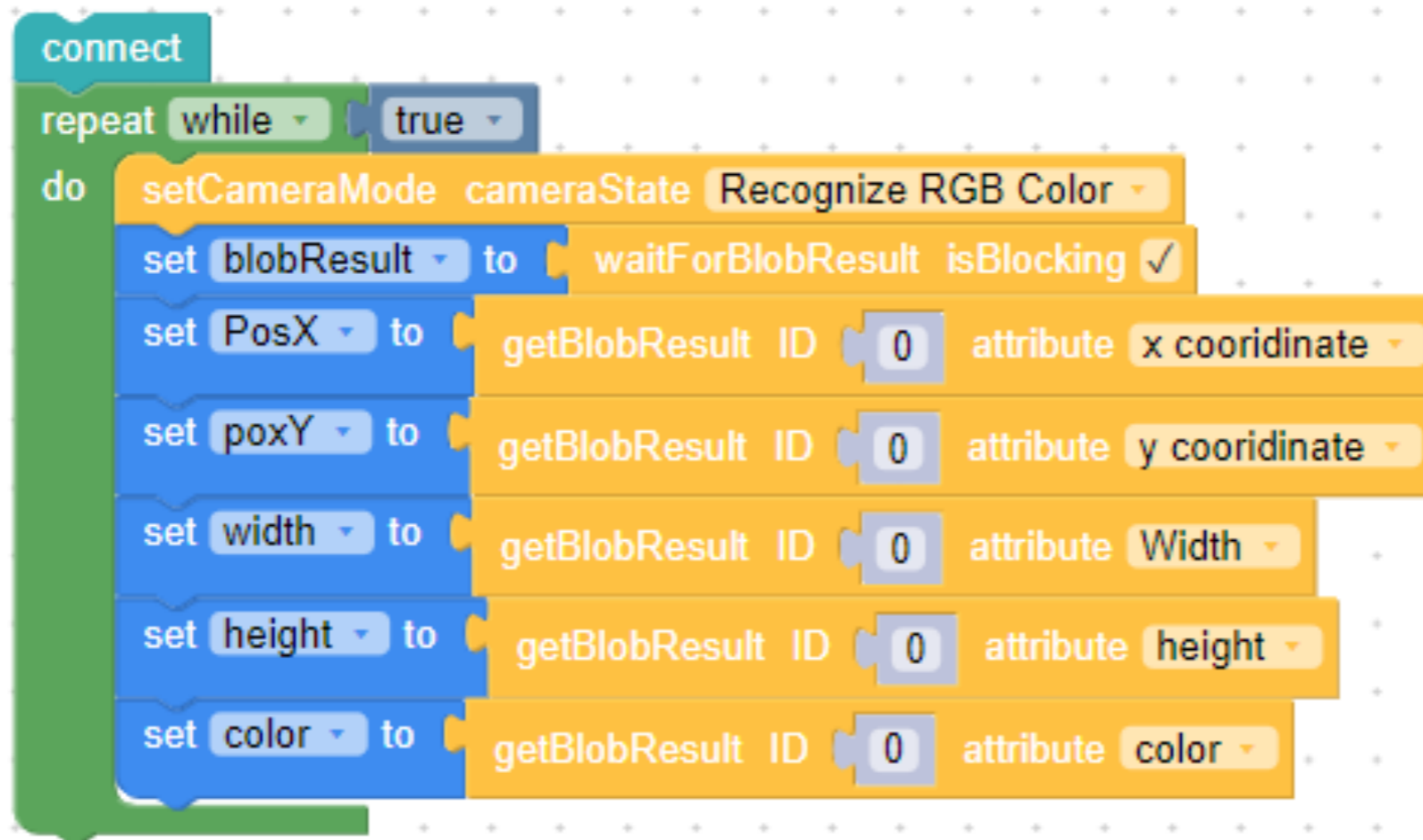
LOKII SIMPLE DEMO (FACE RECOGNITION)

- ▶ We can ask LOKII-CE to do face detection and get the detected (x,y) coordinates

```
connect
repeat while true
do
  setCameraMode cameraState Face detection
  set faceResult to waitForFaceResult isBlocking ✓
  set PosX to getFaceResult x coordinate
  set poxY to getFaceResult y coordinate
  set width to getFaceResult Width
  set height to getFaceResult height
```


LOKII SIMPLE DEMO (COLOR RECOGNITION)

- We can ask LOKII-CE to do Red/Green/Blue color blob detection and get the detected blob attributes.



```
connect
repeat while true
do
  set cameraMode cameraState Recognize RGB Color
  set blobResult to waitForBlobResult isBlocking ✓
  set PosX to getBlobResult ID 0 attribute x coordinate
  set poxY to getBlobResult ID 0 attribute y coordinate
  set width to getBlobResult ID 0 attribute Width
  set height to getBlobResult ID 0 attribute height
  set color to getBlobResult ID 0 attribute color
```

The image shows a sequence of code blocks in a Scratch-like environment. It starts with a 'connect' block, followed by a 'repeat while true' loop. Inside the loop, the code sets the camera mode to 'Recognize RGB Color', waits for a blob result, and then retrieves various attributes (x coordinate, y coordinate, width, height, and color) from the detected blob. Each 'getBlobResult' block has 'ID 0' and 'attribute' selected.

LOKII-CE SIMPLE DEMO (SPEECH RECOGNITION)

- We can set LOKII-CE to recognise a pre-trained keywords group and get the recognition result

```
repeat while (true)
do
  Start speech Recognition for keyword groups: Demo group
  set speechResult to waitForSpeechResult isBlocking (checked)
  if (speechResult = 0)
  do
    stopSpeechRecognize
    Play Text-To-Speech "Tell me a joke" Voice: Default Emotion: Natural Speed: 5 Pitch: 5
  else if (speechResult = 1)
  do
    stopSpeechRecognize
    Play Text-To-Speech "Play me a song" Voice: Default Emotion: Natural Speed: 5 Pitch: 5
  else if (speechResult = 2)
  do
    stopSpeechRecognize
    Play Text-To-Speech "Stop the music" Voice: Default Emotion: Natural Speed: 5 Pitch: 5
```

The image shows a Scratch-style code editor with a grid background. The code is written in a block-based language. It starts with a 'repeat while' loop set to 'true'. Inside the loop, there is a 'do' block containing several steps: 1. 'Start speech Recognition for keyword groups: Demo group'. 2. 'set speechResult to waitForSpeechResult isBlocking' with a checkmark in the 'isBlocking' field. 3. An 'if' block with a condition 'speechResult = 0'. Inside this 'if' block is a 'do' block with 'stopSpeechRecognize' and 'Play Text-To-Speech "Tell me a joke" Voice: Default Emotion: Natural Speed: 5 Pitch: 5'. 4. An 'else if' block with a condition 'speechResult = 1'. Inside this 'else if' block is a 'do' block with 'stopSpeechRecognize' and 'Play Text-To-Speech "Play me a song" Voice: Default Emotion: Natural Speed: 5 Pitch: 5'. 5. Another 'else if' block with a condition 'speechResult = 2'. Inside this 'else if' block is a 'do' block with 'stopSpeechRecognize' and 'Play Text-To-Speech "Stop the music" Voice: Default Emotion: Natural Speed: 5 Pitch: 5'. The code blocks are color-coded: 'repeat while' is green, 'do' is blue, 'if' is purple, and 'Play Text-To-Speech' is light blue.

LOKII-CE SIMPLE DEMO (TEXT-TO-SPEECH AND MIDI)

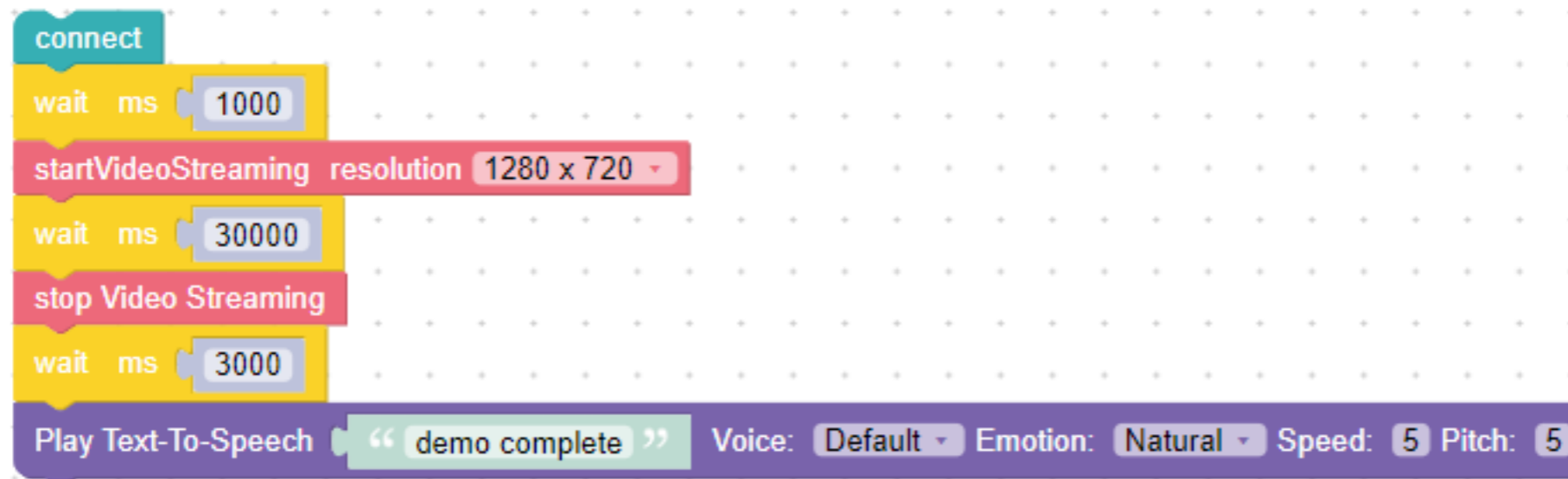
- We can set LOKII-CE to speak out the english Text and also play MIDI notes.

The image shows a Scratch script on a grid background. It starts with a 'connect' block. Below it are four 'Play Text-To-Speech' blocks, each with a text input field and dropdown menus for Voice, Emotion, Speed, and Pitch. The text inputs are: 'Twinkle, twinkle, little star,', 'How I wonder what you are !', 'Up above the world so high,', and 'Like a diamond in the sky.'. The settings for each block are: 1) Voice: Young Girl, Emotion: Friendly, Speed: 5, Pitch: 5; 2) Voice: Man, Emotion: Emotional, Speed: 5, Pitch: 5; 3) Voice: Boy, Emotion: Excite, Speed: 5, Pitch: 5; 4) Voice: Old woman, Emotion: Surprised, Speed: 5, Pitch: 5. Below these are six 'playMIDI note (0-61)' blocks with note numbers 36, 36, 43, 43, 45, and 45, each with a 'time (tempo)' dropdown set to 1.

```
connect
Play Text-To-Speech "Twinkle, twinkle, little star," Voice: Young Girl Emotion: Friendly Speed: 5 Pitch: 5
Play Text-To-Speech "How I wonder what you are !" Voice: Man Emotion: Emotional Speed: 5 Pitch: 5
Play Text-To-Speech "Up above the world so high," Voice: Boy Emotion: Excite Speed: 5 Pitch: 5
Play Text-To-Speech "Like a diamond in the sky." Voice: Old woman Emotion: Surprised Speed: 5 Pitch: 5
playMIDI note (0-61) 36 time (tempo) 1
playMIDI note (0-61) 36 time (tempo) 1
playMIDI note (0-61) 43 time (tempo) 1
playMIDI note (0-61) 43 time (tempo) 1
playMIDI note (0-61) 45 time (tempo) 1
playMIDI note (0-61) 45 time (tempo) 1
```

LOKII-CE SIMPLE DEMO (VIDEO AND AUDIO STREAMING)

- We can set LOKII-CE to do video streaming and audio streaming to an external device. (Current demo support Android device)



LOKII-CE SIMPLE DEMO (SMART MOTOR CONTROL)

- We can set LOKII-CE to control SMART devices (RGB lights, DC motors) based on their unique IDs in the SMART_BUS.

```
connect
showSmartDeviceStatus showDevice ✓
setRGB ID 1 r 0 g 0 b 255
moveMotor ID 9 speed 50 position 100 direction 1
wait ms 1000
setRGB ID 1 r 0 g 255 b 0
moveMotor ID 9 speed 0 position 1 direction 0
wait ms 1000
setMotorPower ID 9 state OFF
setRGB ID 1 r 255 g 0 b 0
record Motors for 10 seconds
setRGB ID 1 r 0 g 255 b 0
playback Motors
setRGB ID 1 r 0 g 0 b 0
set result to readMotorPosition ID 9
```

LOKII-CE TECHNOLOGY ROADMAP

LOKII-CE SMART_IOT (COMING)

- A bluetooth 5.0 wireless remote IOT sensor device will be coming.
(SMART_IOT)
- This sensor device will be FCC /CE /BQB certified and provides sensor data collecting:
 - Temperature / Humidity
 - CO2/ TVOC concentration
 - Light Intensity / Proximity distance
 - Accelerometer/Gyrometer /Magnetometer
 - Environmental sound level



LOKII-CE SMART_IOT (COMING)

- Each LOKII-CE board can pair and connect up to 8 x SMART_IOT device through Bluetooth 5.0 long range protocol.
- User can collect sensor data to SMART_SHIELD for programming
- User can publish these sensor data to LOKII-CE cloud platform for post processing.

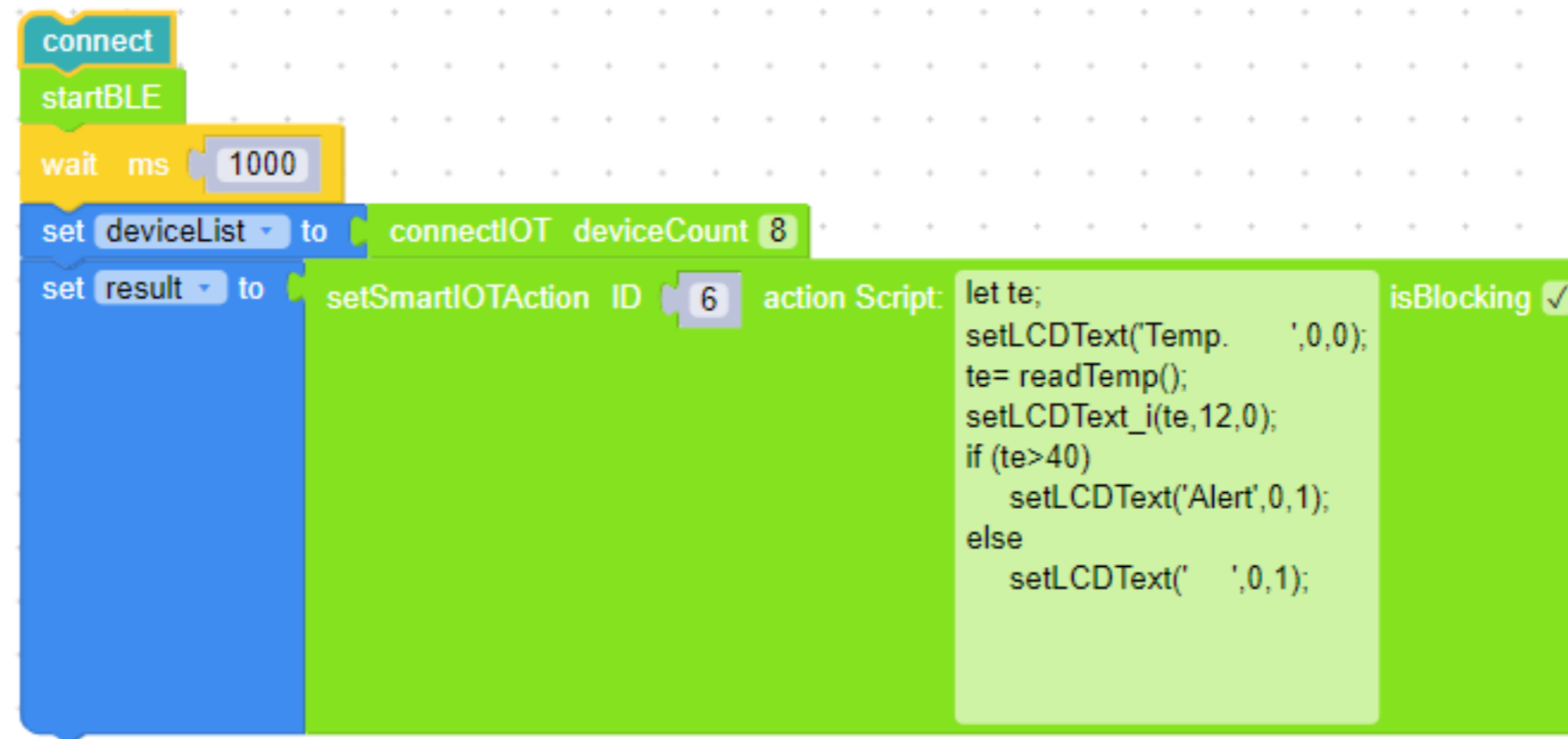
COMING FEATURES (AFTER RELEASE OF SMART_IOT)

- We can set LOKII-CE to read up to 8 x SMART_IOTs remote sensors.

```
connect
startBLE
set deviceList to connectIoT deviceCount 8
if not deviceList is empty
do
  set ID to in list deviceList get # 1
  set temperature to read SmartIoT ID ID sensor Temperature(c)
  set humidity to read SmartIoT ID ID sensor Humidity(%)
  set co2 to read SmartIoT ID ID sensor CO2(ppm)
  set tvoc to read SmartIoT ID ID sensor TVOC
  set lightIntensity to read SmartIoT ID ID sensor Light intensity(LUX)
  set distance to read SmartIoT ID ID sensor Distance(mm)
  set soundVolume to read SmartIoT ID ID sensor Sound(dB)
  set accelerometerX to read SmartIoT ID ID sensor Accelerometer X
  set gyroX to read SmartIoT ID ID sensor Gyro X
  set magnetometerX to read SmartIoT ID ID sensor Magnetometer X
  set rgbColor to read SmartIoT ID ID sensor RGB Color
  show text on LCD create text with "Humidity" row 5
  humidity
```

COMING FEATURES (AFTER RELEASE OF SMART_IOT)

- We can set LOKII-CE to set action scripts for each SMART_IOT (Each SMART_IOT can run its own program)



The image shows a sequence of code blocks for configuring a SMART_IOT device. The blocks are:

- connect** (teal)
- startBLE** (green)
- wait ms 1000** (yellow)
- set deviceList to connectIOT deviceCount 8** (blue)
- set result to setSmartIOTAction ID 6 action Script: [script] isBlocking ✓** (blue)

```
let te;  
setLCDText('Temp. ',0,0);  
te= readTemp();  
setLCDText_i(te,12,0);  
if (te>40)  
    setLCDText('Alert',0,1);  
else  
    setLCDText(' ',0,1);
```

COMING FEATURES (AFTER RELEASE OF SMARTIOT)

- We can set LOKII-CE to connect 8 x SMART_IOTs remote sensors and upload these sensors values for post processing in LOKII-CE cloud platform.

```
connect
startBLE
wait ms 1000
set deviceList to connectIoT deviceCount 8
set result to publishIOTData updateSeconds 5
wait ms 60000
set result to publishIOTData updateSeconds 0
closeBLE
```

The image shows a Scratch script on a grid background. The script consists of the following blocks: a 'connect' block, a 'startBLE' block, a 'wait ms' block with the value '1000', a 'set deviceList to' block with a 'connectIoT' block and 'deviceCount' set to '8', a 'set result to' block with a 'publishIOTData' block and 'updateSeconds' set to '5', another 'wait ms' block with the value '60000', a final 'set result to' block with a 'publishIOTData' block and 'updateSeconds' set to '0', and a 'closeBLE' block.