



ASHISH SUREKA (Principal Scientist, ABB Corporate Research Center)

# Enabling Simplified Robot Programming using Block Based Coding

## Reducing Programming Complexity for increasing Adoption

# Presentation Outline

## Focus: Block-Based Visual Programming for Industrial Robots

### Industrial Robots



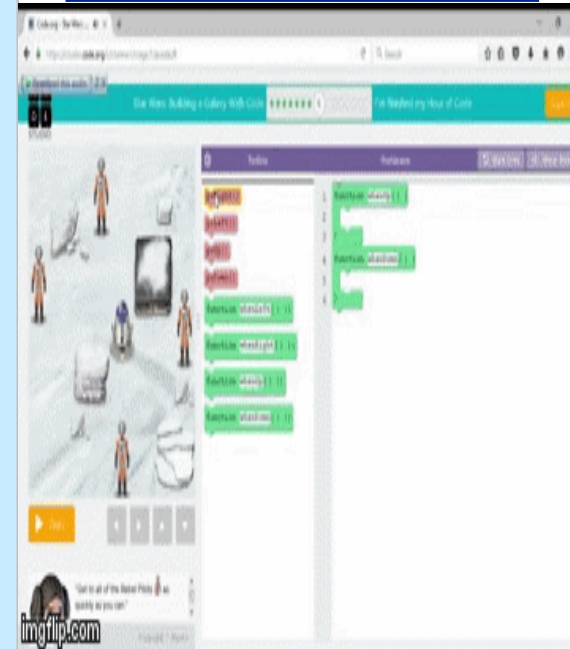
### Programming Methods

#### Teach Pendant Programming (Teach Box)



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### Block-Based Coding



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### Easy Programming



**Enabling Easy Programming for Industrial Robots – Increasing Adoption by Masses**

# Robots – Types & Applications

Military, Medical, Space, Agriculture, Household, Factory

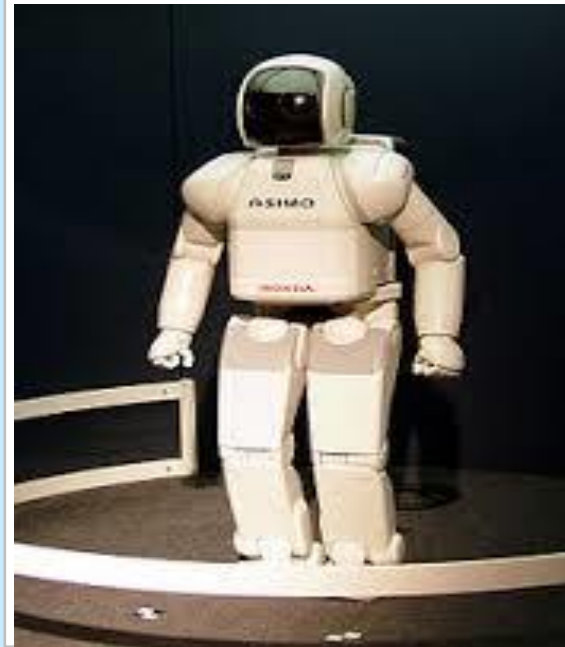
Drones



Space Robots



Humanoid



Industrial



**Robotics and related services will hit \$135.4 billion in 2019 [IDC, Fortune]**

# Industrial Robots - Robotic Manipulators

Automation and modernization of a manufacturing process in any industry



Controller and a manipulator arm  
Arm and Body  
Joints connected links  
Wrist

Spot welding and arc welding  
Mainly used by automotive industry  
Improves efficiency and accuracy

**Robots are available to weld parts of all shapes and sizes**

# Robotic Material Handling

6-7 degree of freedom arms for orienting and positioning objects



Machine tending, press tending  
Part transfer,  
Case packing and palletizing  
Logistics

Industrial Robot Manufacturers (Examples)  
[1] ABB [2] Fanuc [3] Kawasaki  
[4] Kuka [5] Rethink [6] Yaskawa  
[7] Universal

**Automation of the most tedious, dull, and unsafe tasks in a production line**

# Industrial painting and coating robots

Without leaving behind drips, inconsistencies, overspray – High finishing quality



Metallic material will be painted at the final stage of production in order to protect it from corrosion

Finished metals are painted with different colors

Coating process is often a multi-step process

Dramatically lowers operating costs

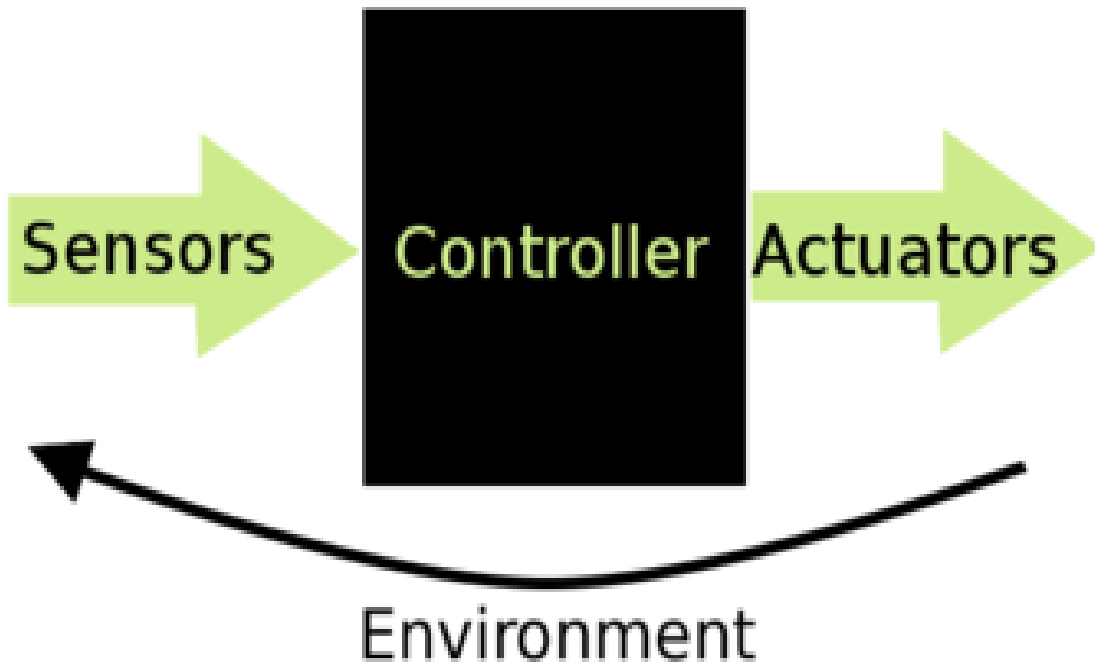
Decreases wasted material

**One of the earliest applications for industrial robot**

# Robot – Key Components

## Common elements and parts of all robots

### Controller (Brain of the Robot)



### Sensor and Actuator

**Sensor** measure robot configuration and its environment and send such information to robot controller as electronic signals

**Actuator** Electro-mechanical devices like motors

### Controller

Provide necessary intelligence to **control the manipulator/mobile robot**. Process the sensory information and **compute the control commands** for the actuators to carry out specified tasks

# Robot Programming Techniques - Teach Method

Robot is taught the positional data using a teach pendant

Teach Pendant Programming  
(Teach Box)



Teach Pendant Programming  
(Teach Box)

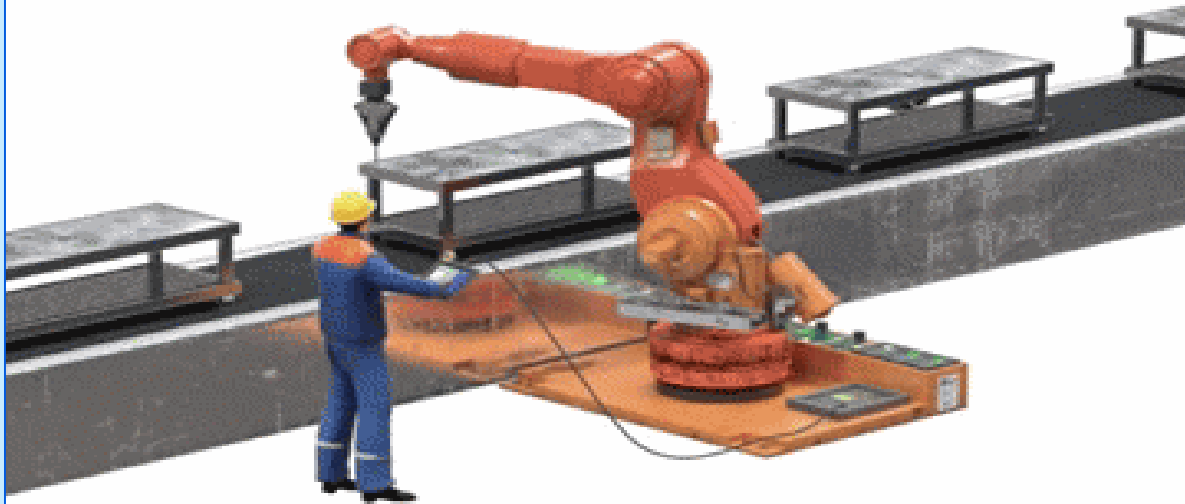


Allow precise positioning, as the robot can be programmed using numerical coordinates



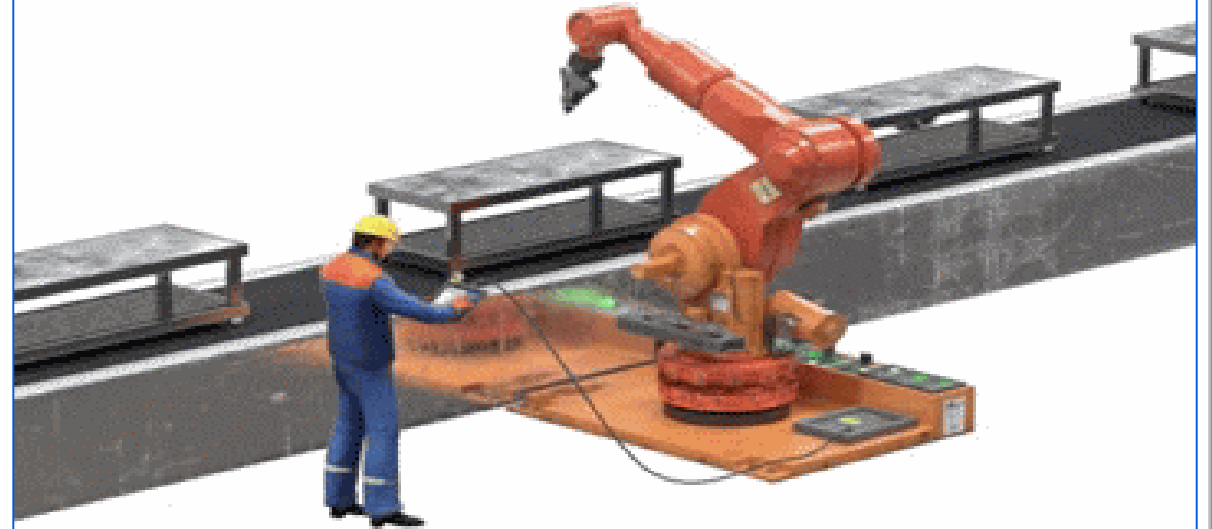
Teach pendants - handheld devices and may be wired or wireless  
Locations are stored with names that can be used within the robot program

Teach Pendant Programming  
(Teach Box)



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Teach Pendant Programming  
(Teach Box)



imgflip.com

**No special programming skills required**

# Lead-through programming

Program is taught in the teach mode, and it is executed in the run mode

Teach Pendant Programming  
(Teach Box)



Lead Through Programming



Manual Lead-through Method - End effector is moved physically by the programmer

# Off-line methods of programming

## Computer-like Programming - textual or visual language



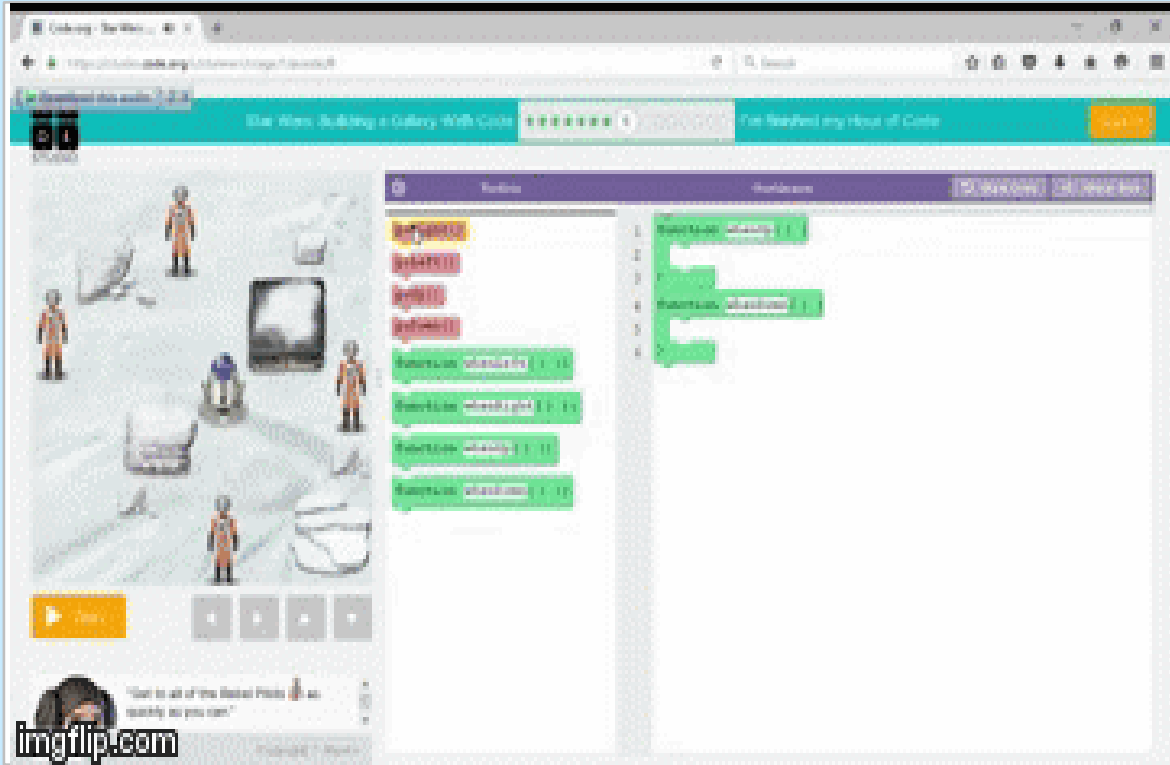
The use of **enhanced sensor capabilities**, including the use of analogue and digital inputs  
**Advanced computation** and data processing capabilities

Requires **specialized knowledge** of the programming language and offline software  
Not for **non-programmers**

**Extended program logic, beyond lead-through capabilities**

# Hour of Code - one-hour introduction to computer science

Global movement reaching tens of millions of students in 180+ countries



Drag & Drop block-based game  
Becoming increasingly de facto as a way to introduce students of all ages to code  
Computer coding syntax bugs taken-off

Anyone, anywhere can organize an Hour of Code event.  
One-hour tutorials are available in over 30 languages  
No experience is needed... Ages 4 to 104

**Every student in every school should have the opportunity to learn computer science**

# OzoBlockly - Powered by Google's Blockly

## Drag and Drop programming using icon-based blocks



**Visual editor** which allows to create programs by **plugging blocks together**. The blocks can be used to control Ozobot's behavior like movement, LED lights, etc.

Rotate Right or Left – 90° turn  
Rotate Slightly Right or Left – Aprox. 45° turn  
Steps – a unit of movement forward

**Write a computer program to teach a robot to do a task**

# Easy-to-use graphical blocks

Each block represents an individual command from the “text-based” language



Easily drag and drop lines of code onto the work area to start coding

Programming is not just for geeks, it's for everyone

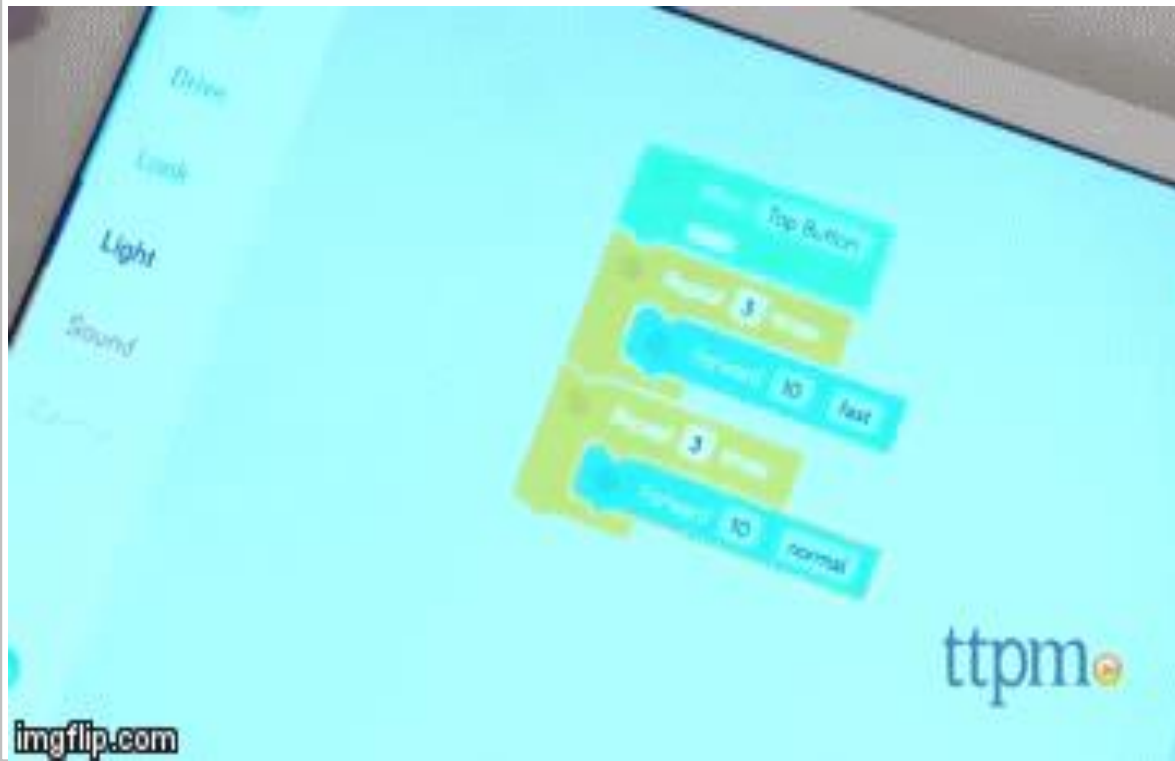
Programming improves analytical thinking and logical reasoning

**Visual programming language (VPL)** is any programming language that lets users create programs by manipulating program elements graphically rather than by specifying them textually

**One of the Easiest Programming Language in the World**

# Dash and Dot - Kid-friendly robots that teach programming

## Makes programming intuitive



Visual programming interface

Intuitive and kid-friendly way of presenting coding and robotics

seeing the robot running through the programming sequences on the screen

Dash has distance sensors at the front and rear along with three microphones to detect sound direction. Dot can also hear sounds and has an accelerometer to detect tilting, shaking, movement.

**Everything to do with robotics involves elements of programming or coding**

# Problem Definition and Motivation ?

## Enable Easy Programming for Non-Programmers and Non-Engineers



**Democratizing YuMi Programming**

Try Before Buy



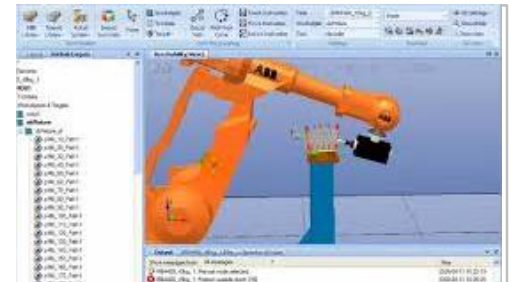
High-Level Abstractions



Non-Text Based



RobotStudio Integration





# Solution Approach – Block Based Coding Integrated to Robot Studio?

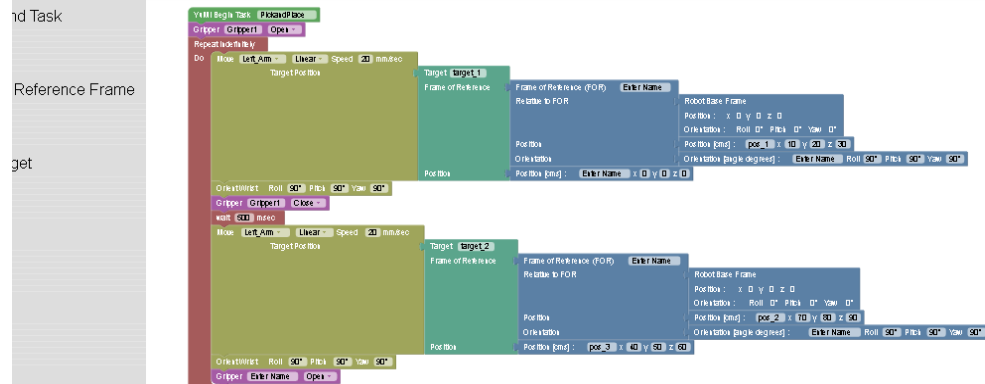
## Blockly: Simple, Intuitive, Visual Development, Drag and Drop

### Pick and Place Control Flow

Touch Friendly Drag and Drop Block Based Visual Programming System for YuMi ABB

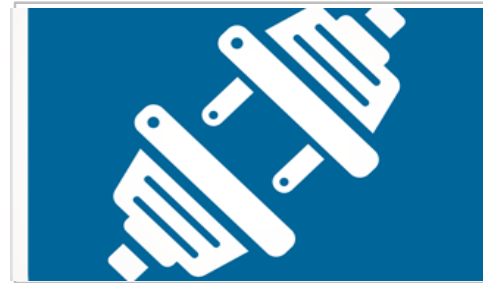


Programming Canvas



YuMi Programming for Non-Programmers

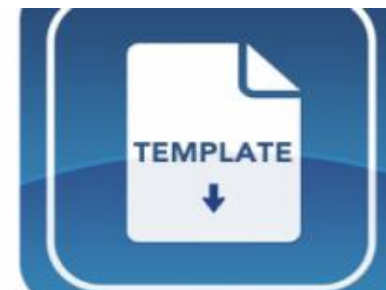
### RobotStudio AddIn



### Visual Programming



### Templates



### Touch Friendly



# Solution Stack and Technology Used

## Easily Extensible and Well-Integrated with ABB RobotStudio Infrastructure

Front-End : Block Based Programming (Easiest Programming Language in the World)

RobotStudio



Offline Programming Environment

Blockly



Visual Block Programming Editor

RAPID



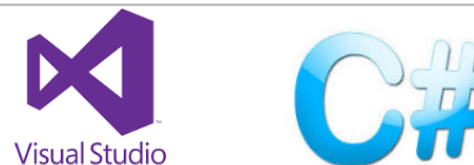
ABB Robotics Text Based Language

JavaScript, HTML and CSS



User Interface

Robot Studio C# API/SDK



RobotStudio API Interface

Microsoft .NET Framework



Framework and Platform

Power and productivity  
for a better world™

