Introduction to Engineering Using Robotics Laboratories

Event-Driven Programming and Sensor Programming

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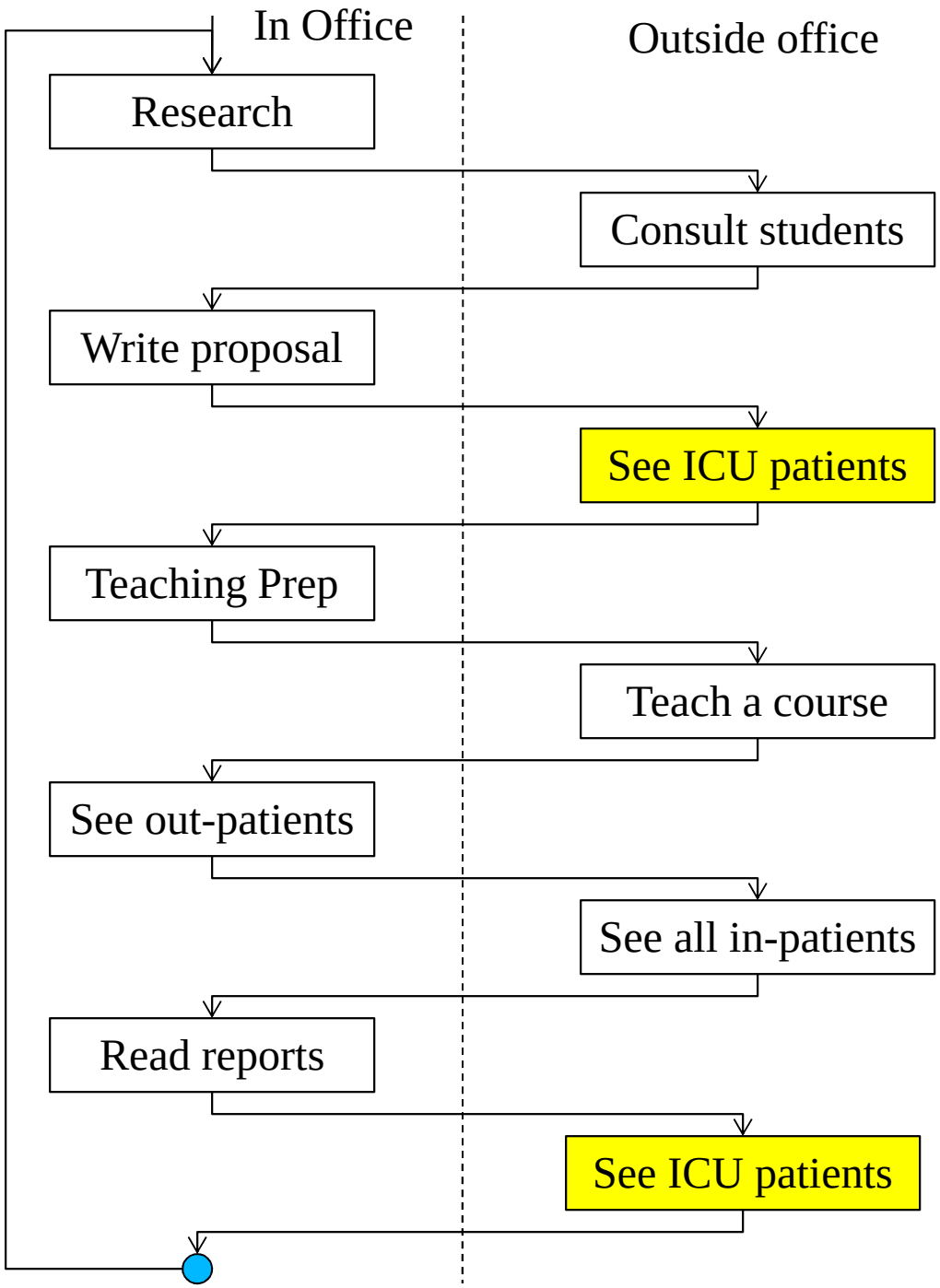
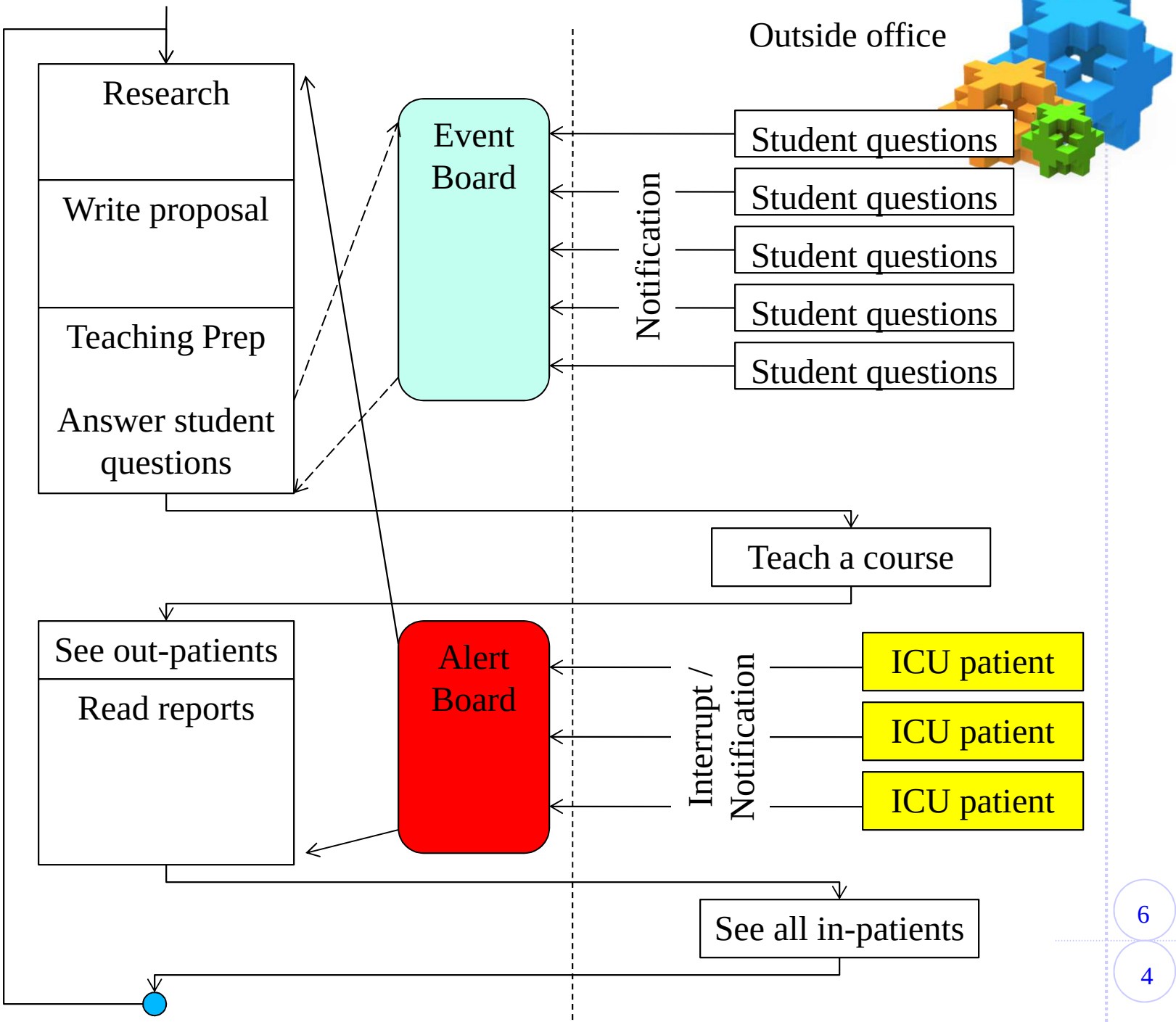
Routine of a Medical Professor in Control Flow Mode



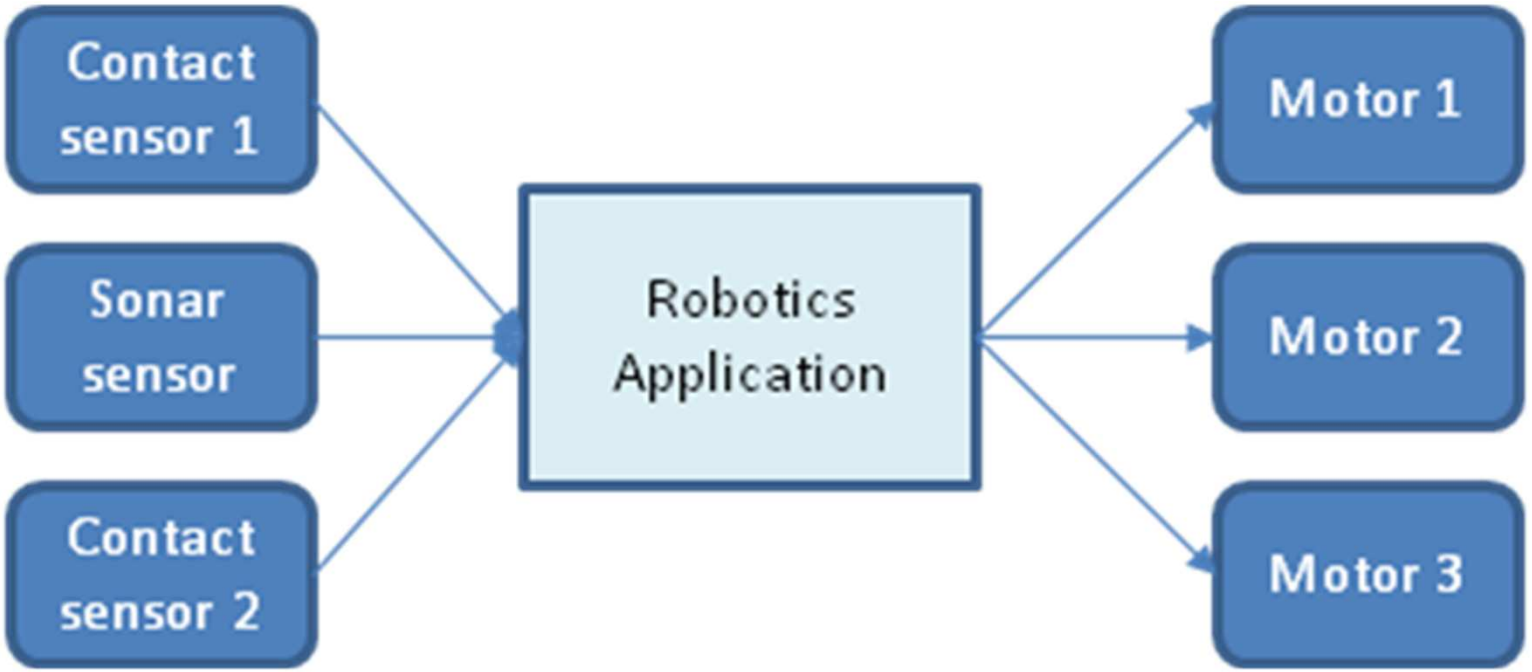
Routine of Medical Professors in Event-Drive Mode

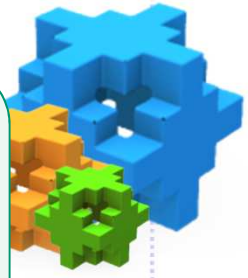


Event-Driven Programming

- Event-driven programming is a computing paradigm which allows interaction between the computer program and the user;
- The execution flow of the program is determined by
  - user actions, such as mouse clicks, key presses, sensor outputs (e.g., touch sensor), and
  - messages from other programs
- It assumes that there are unlimited number of processors available, and the events can be handled immediately.

Sensors and Actuators in Robotics Application





Touch Sensor

Event emitter

T_1

T_2

T_m

Notify handler T_1

Notify handler T_2

Notify handler T_m

Notify handler S_1

Notify handler S_2

Notify handler S_n

S_1

S_2

S_n

Sonar Sensor

Event emitter

Alert

Handler Touch

Handler Sonar

Frequency of reading

Main program in a loop

Light Sonar

Handler Motor 1

Handler Motor 2

Motor 1

Motor 1 control

Motor position

Event emitter

M_1

Notify handler M_1

Motor 2 control

Motor 2

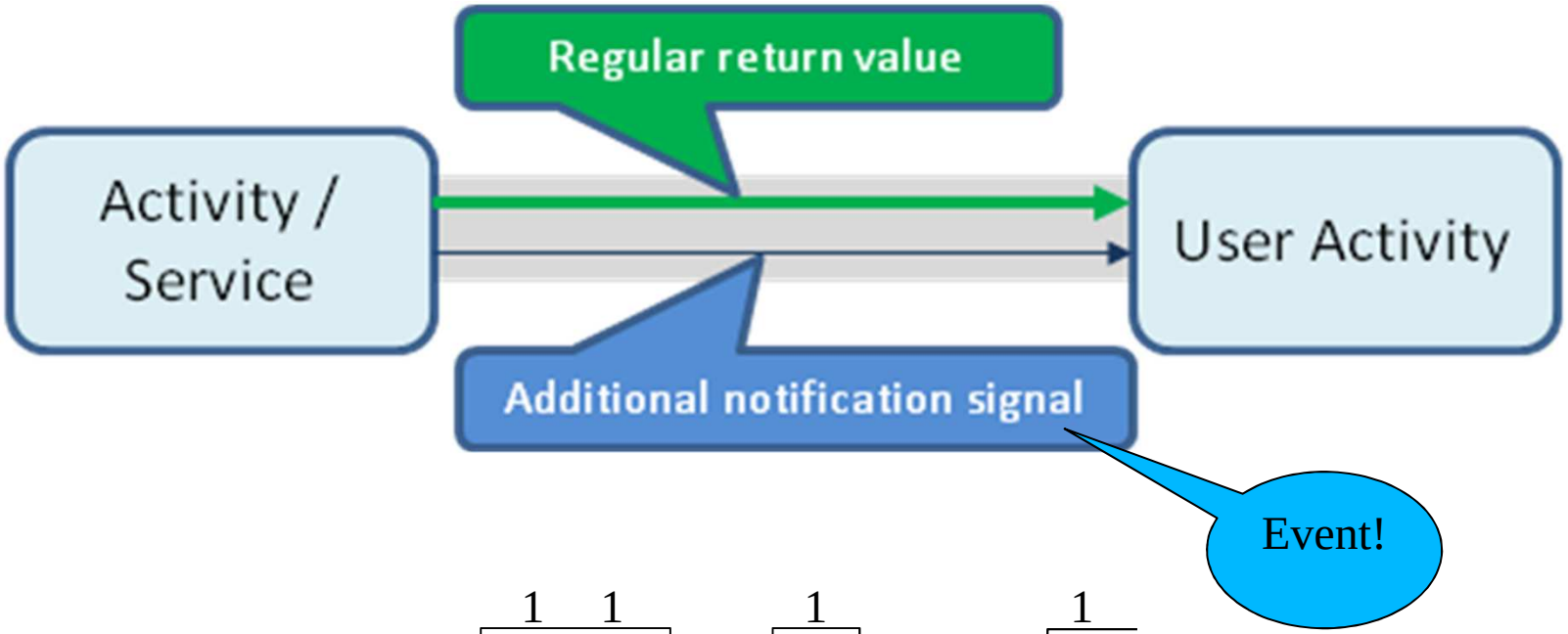
Motor position

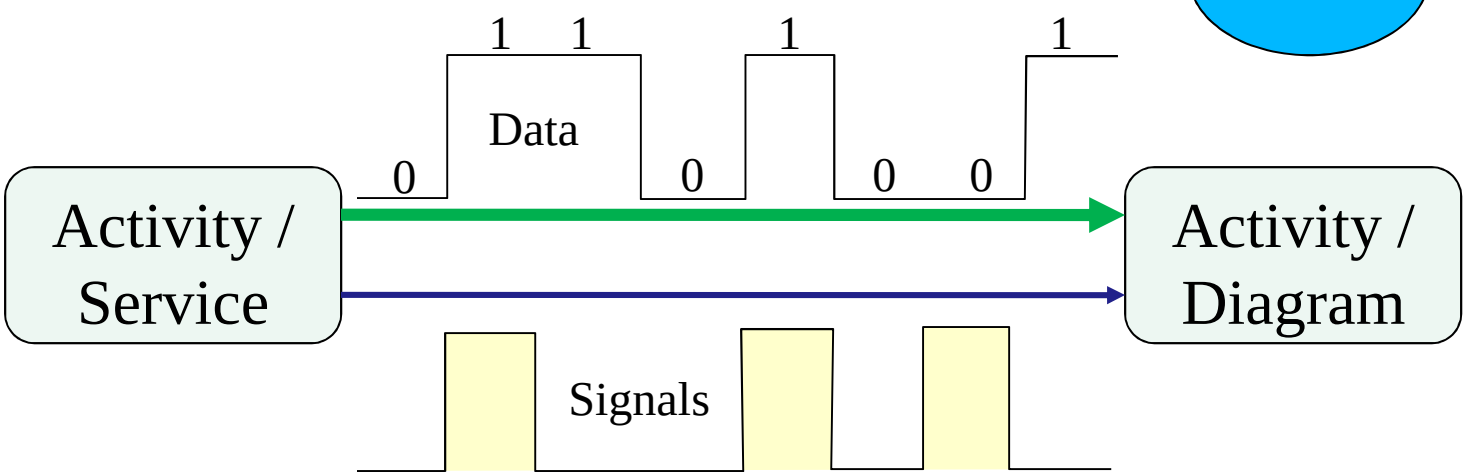
Event emitter

M_2

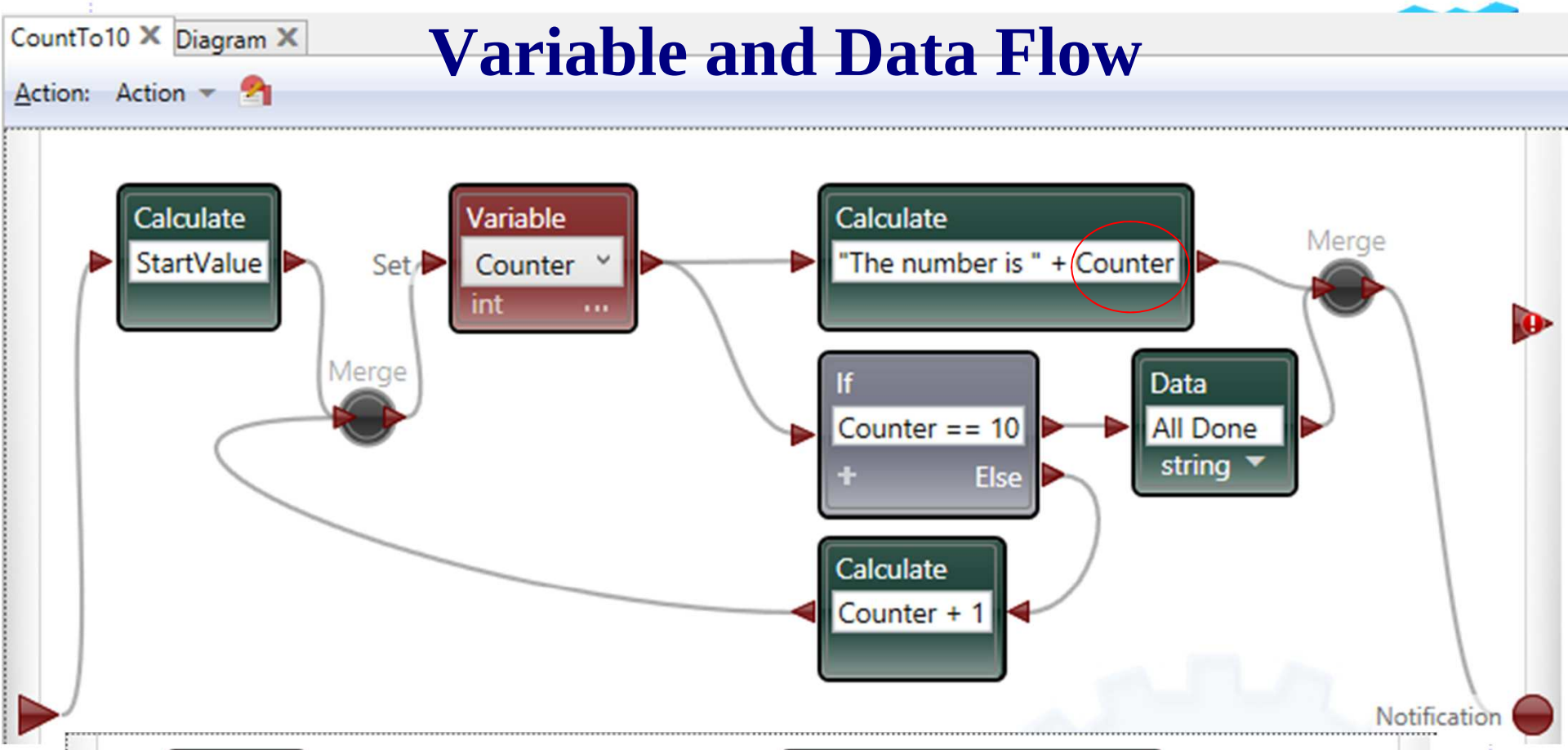
Notify handler M_2

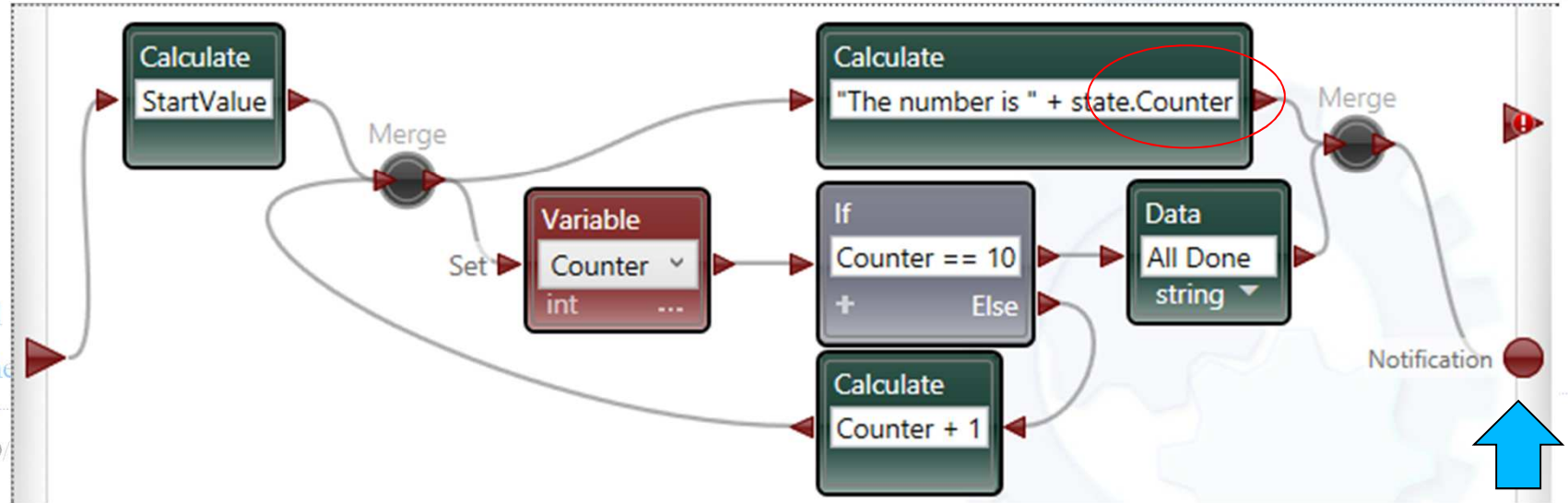
Communication between Activities / Services in VPL



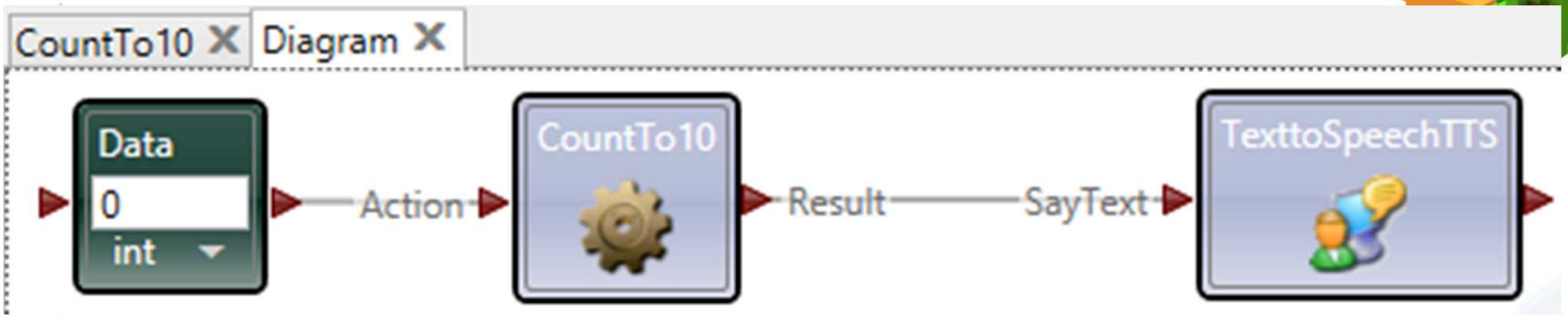


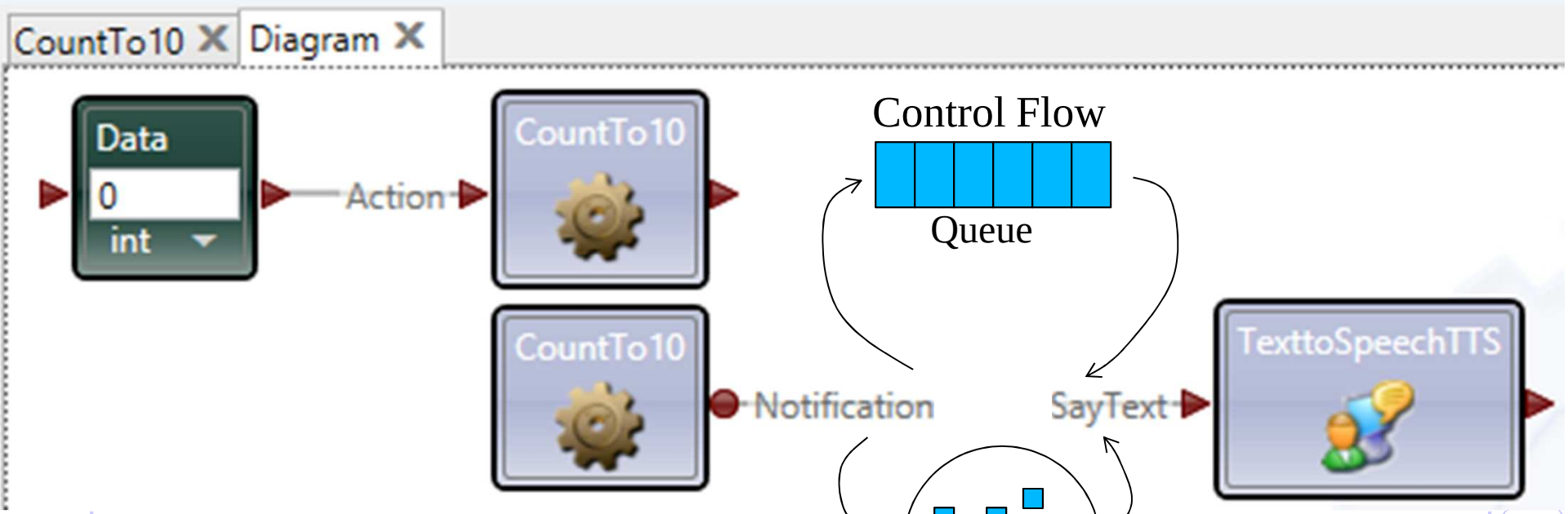
Variable and Data Flow





Data Output versus Notification Output



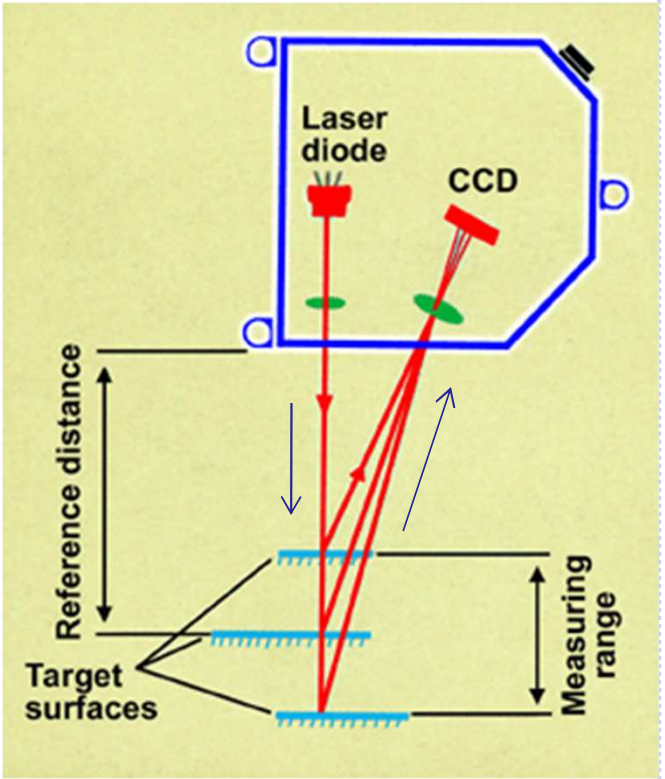


Event Driven:
All will be done at the same time, but

Set

Types of Sensors

- Ranging sensors, such as
  - sonar,
  - ultrasonic,
  - IR, and
  - laser sensors:
- These sensors return the distance to the object.
- They typically have two lens (eyes). One sends out a light beam and the other receives the reflected beam.
- By measuring the time and angle of reflected beam, as shown in the Figure on the right, the sensors can measure the distance to the object

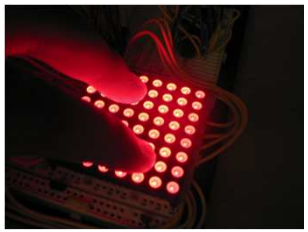


Types of Sensors

There are many types of sensors

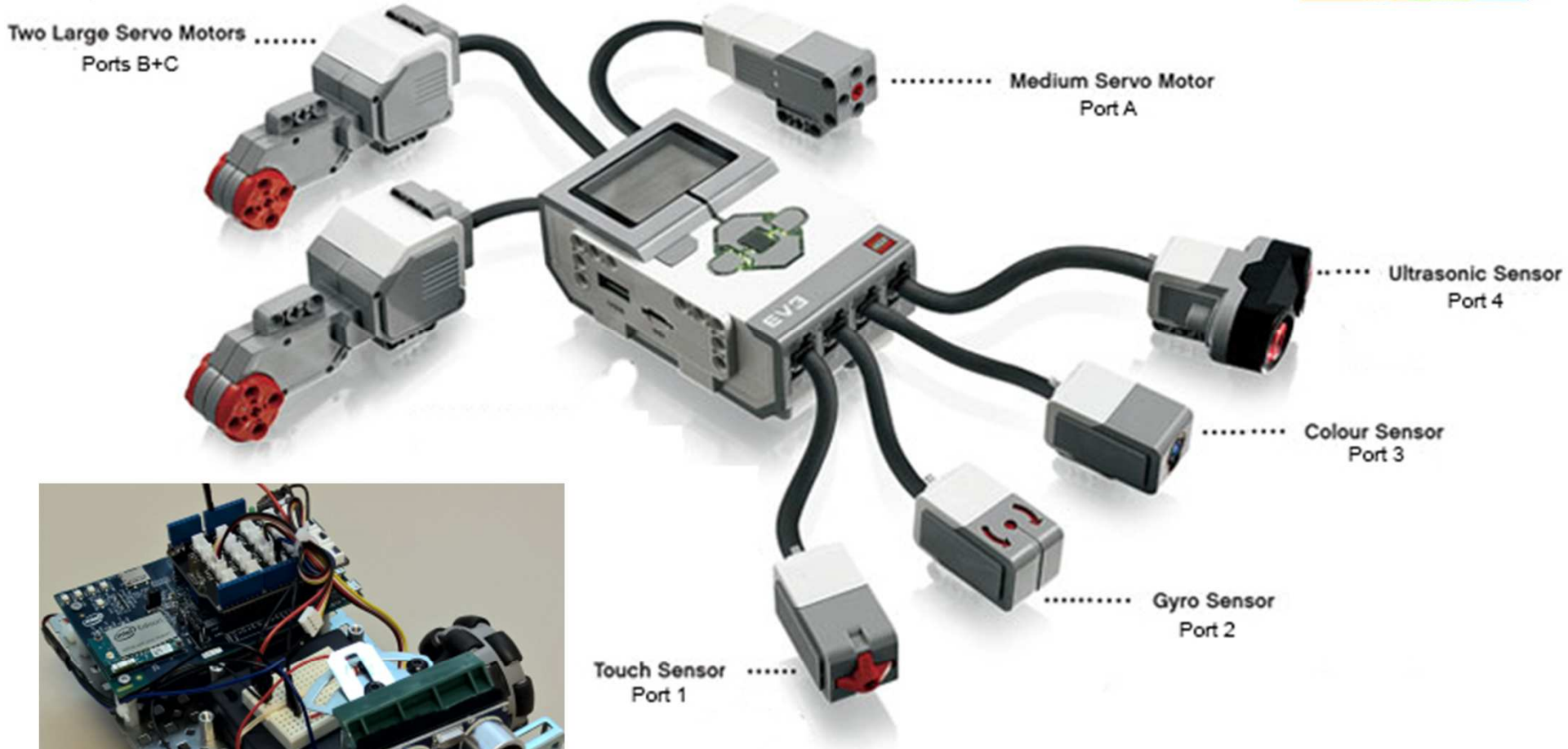
- Contact (touch) sensor: A signal is generated when touched



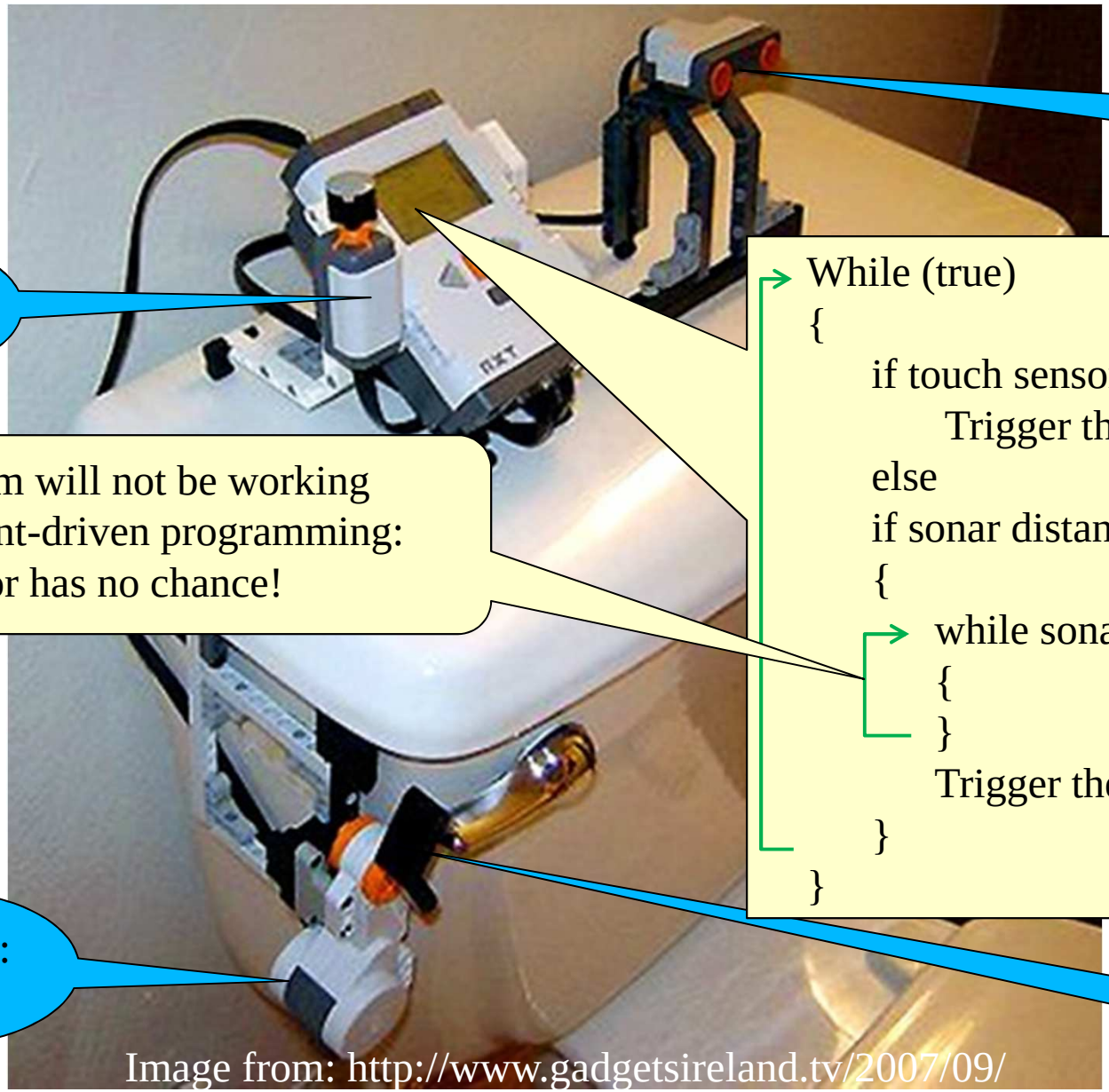



- Compass (magnetic) sensor
- GPS (Global Positioning System)
- Color sensor: return different value for different colors
- Temperature sensor
  Return the temperature
- Vehicle accelerometer sensor
- Vehicle tire pressure sensor
- …

EV3 and Edison Robots



Example: NXT Robot and An Application



Sonar Sensor

Touch Sensor

This program will not be working without event-driven programming: Touch sensor has no chance!

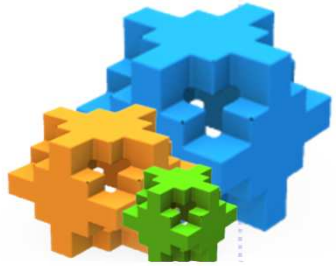
```
While (true)
{
    if touch sensor value == 1
        Trigger the motor;
    else
    if sonar distance < 3 feet
    {
        while sonar distance < 5
        {
        }
        Trigger the motor;
    }
}
```

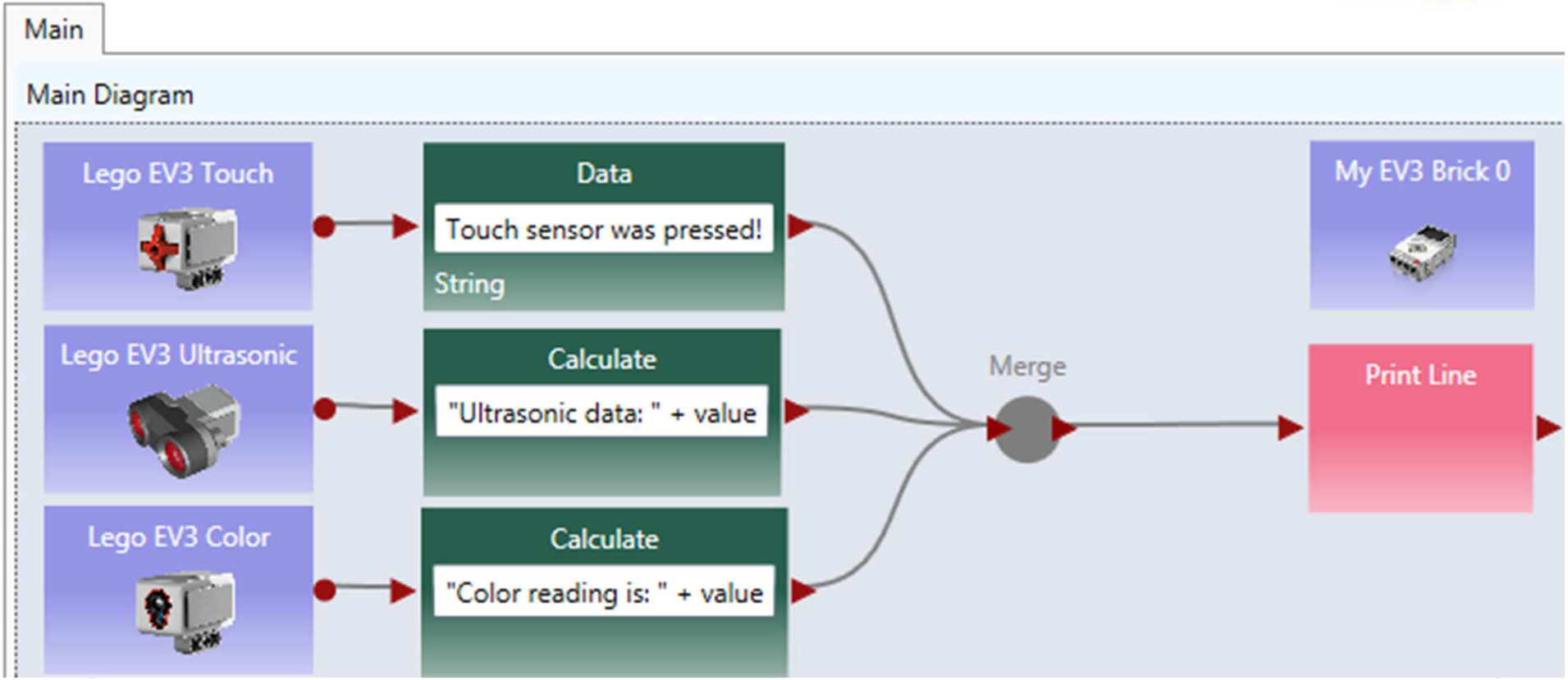
Actuator: Motor

Effector: Finger

Image from: http://www.gadgetsireland.tv/2007/09/

Test Sensors in ASU-VPL





A Line-Follower Program Using Color Sensor