Monitoring your Lego Mindstorms™ with Giotto

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Motivations

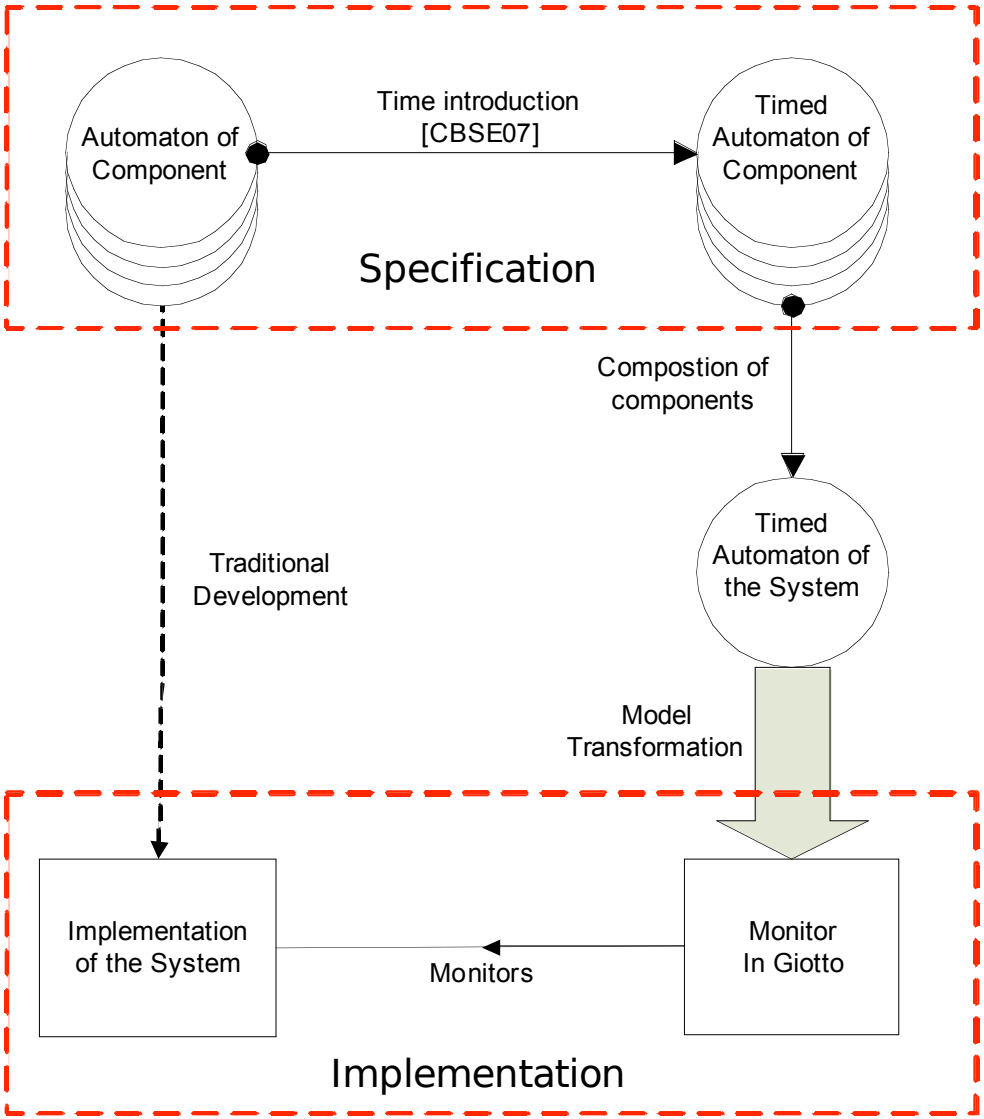
- to merge a formal model for timing specification with ‘classical’ components
- to build a process based on model driven engineering
- to cover time issues in classical applications (e.g. cooperative edition, shared spaces, i.e. applications where late results are not catastrophic but useless)

Mindstorms and LeJOS

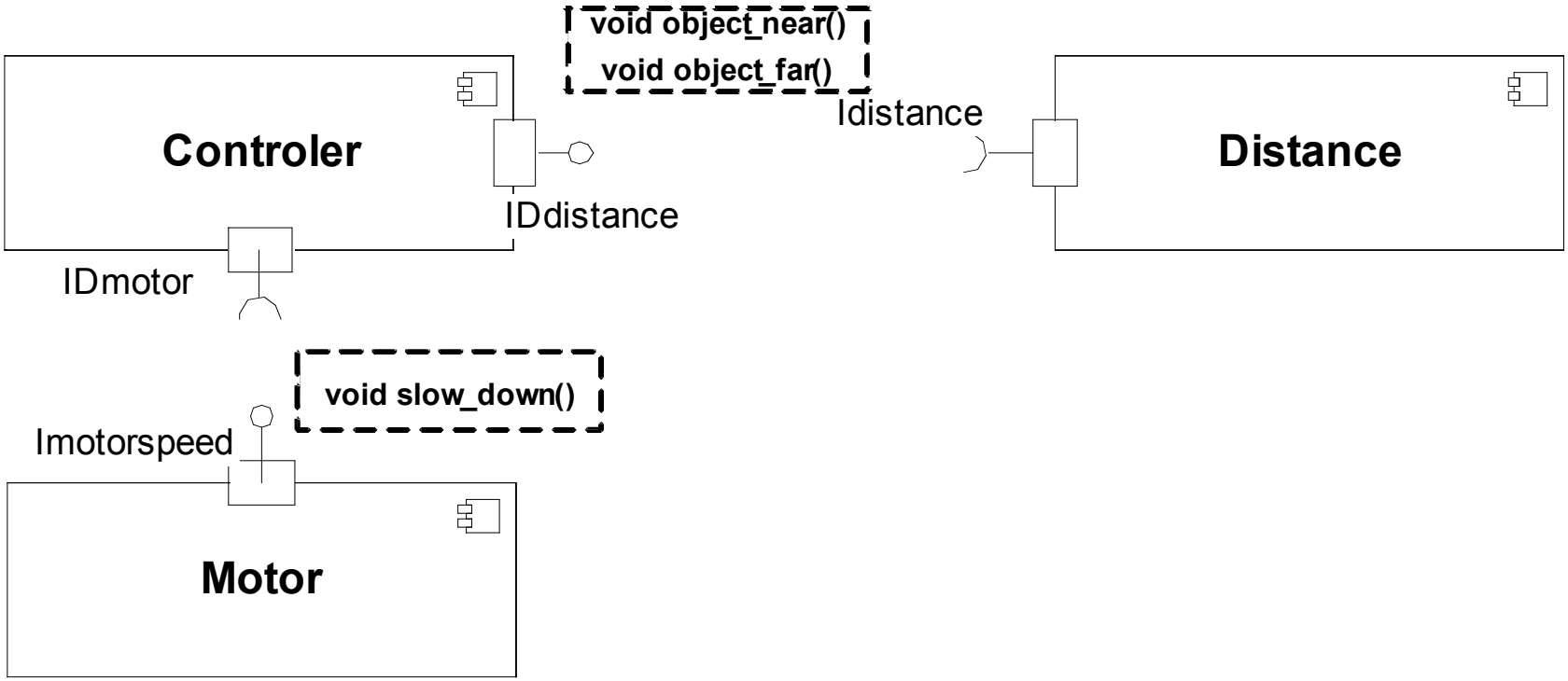
Technical specifications
32-bit ARM7 microcontroller
256 Kbytes FLASH, 64 Kbytes RAM
8-bit AVR microcontroller
4 Kbytes FLASH, 512 Byte RAM
Bluetooth wireless communication
(Bluetooth Class II V2.0 compliant)

leJOS is a Java based replacement firmware for the Lego Mindstorms

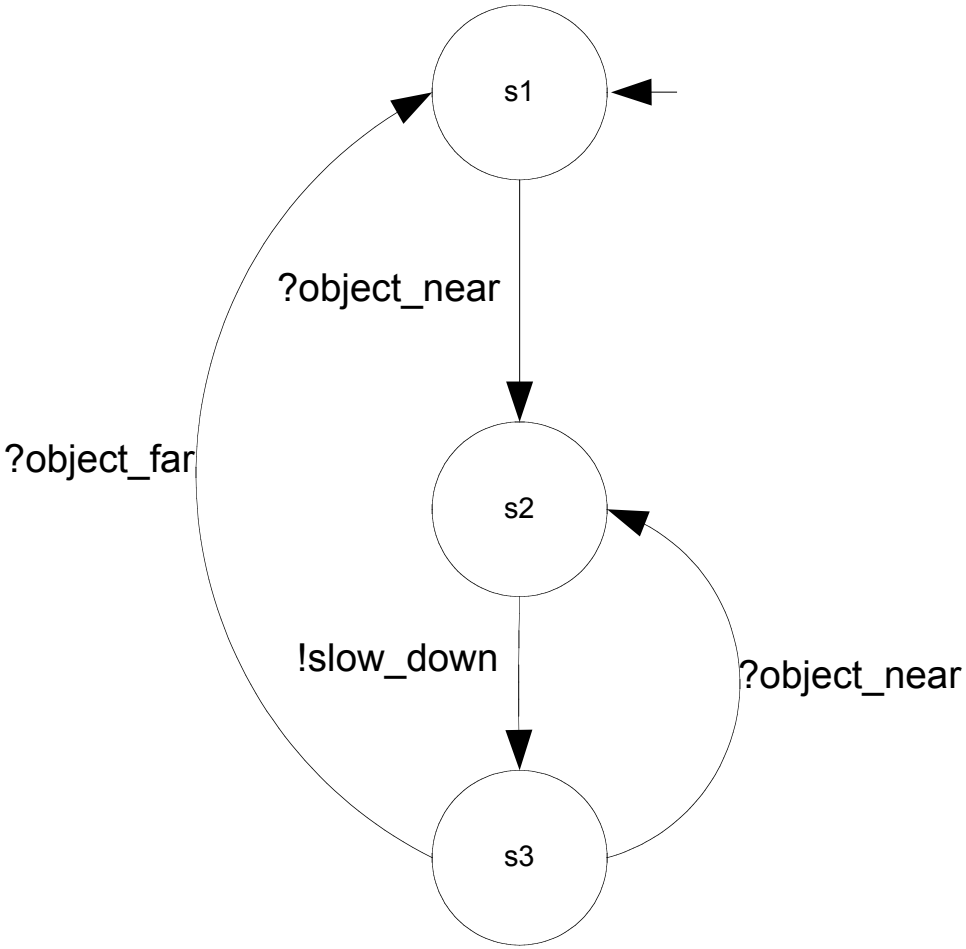
Overview of the process



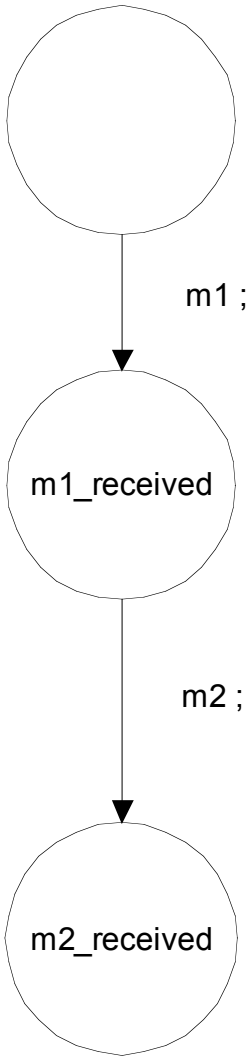
Example


void object_near()
void object_far()
Idistance
Controler
Distance
IDdistance
IDmotor
void slow_down()
Imotorspeed
Motor

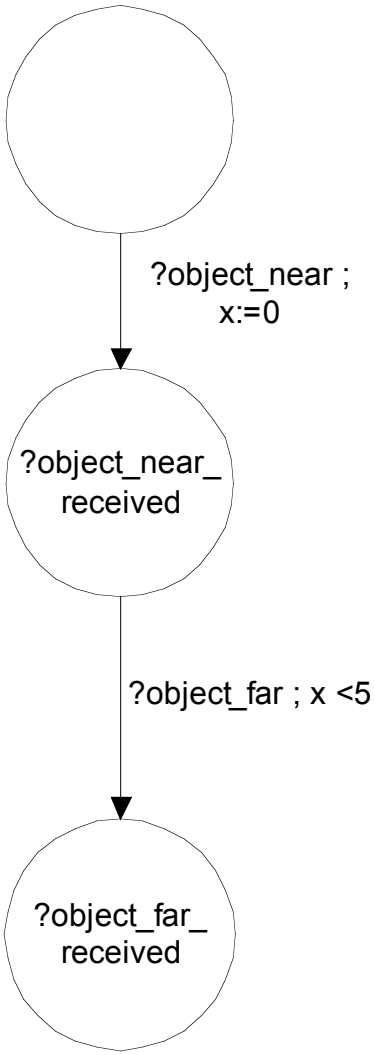
Behaviour



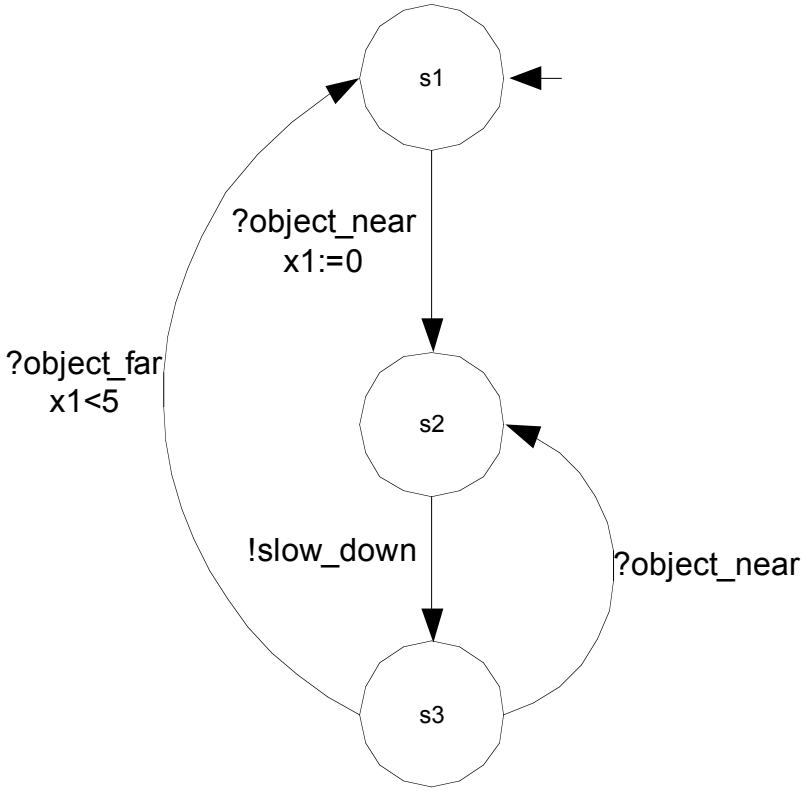
Applying duration pattern



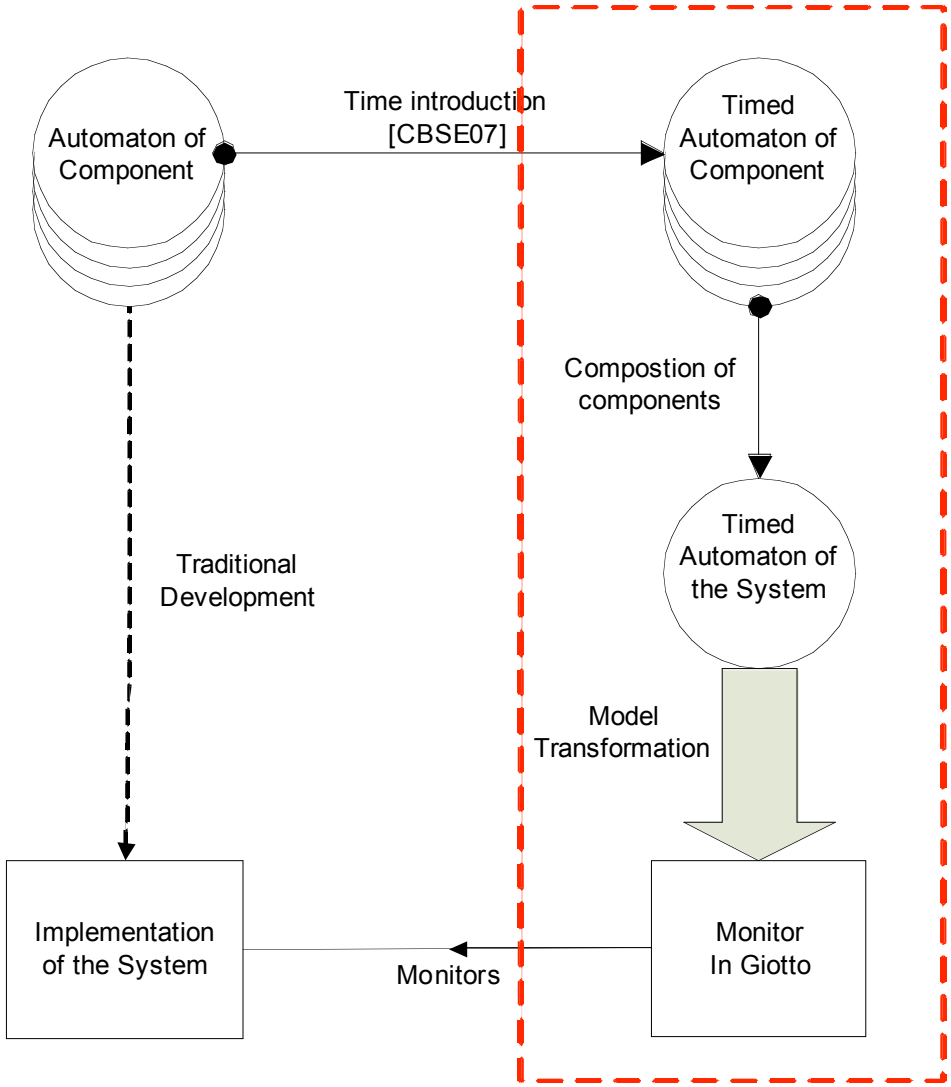
Generic duration pattern



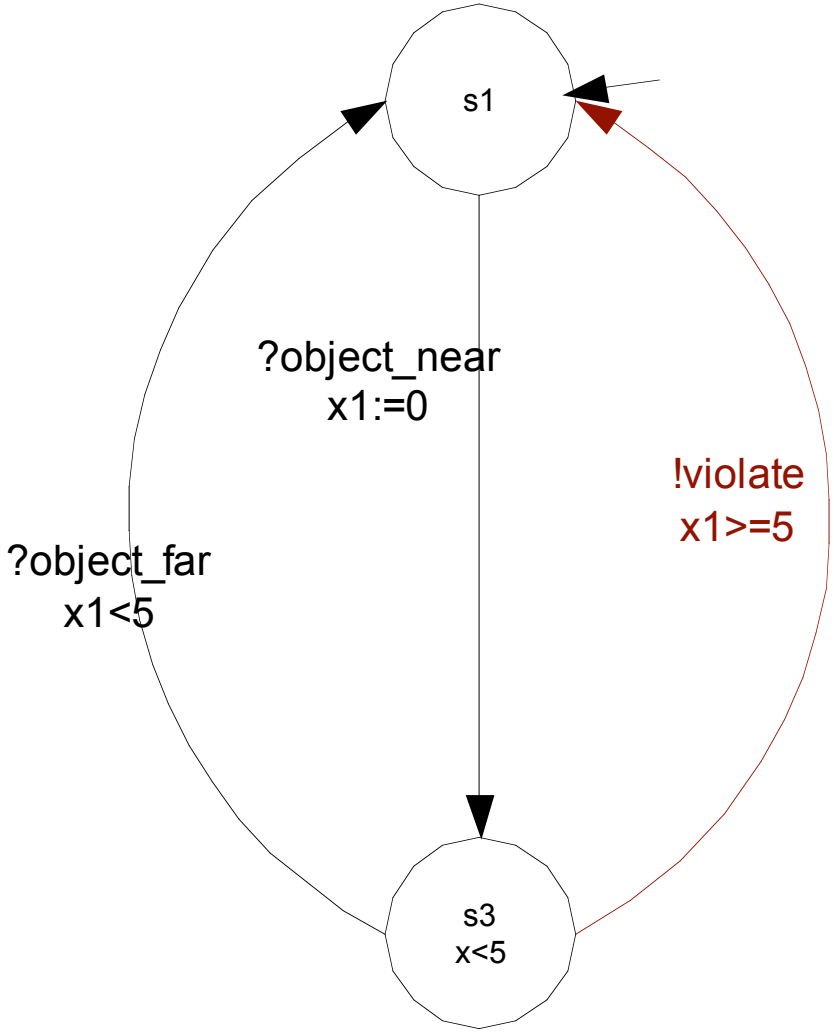
Duration pattern
(?object_near,?object_far,<,5)



Overview of the process

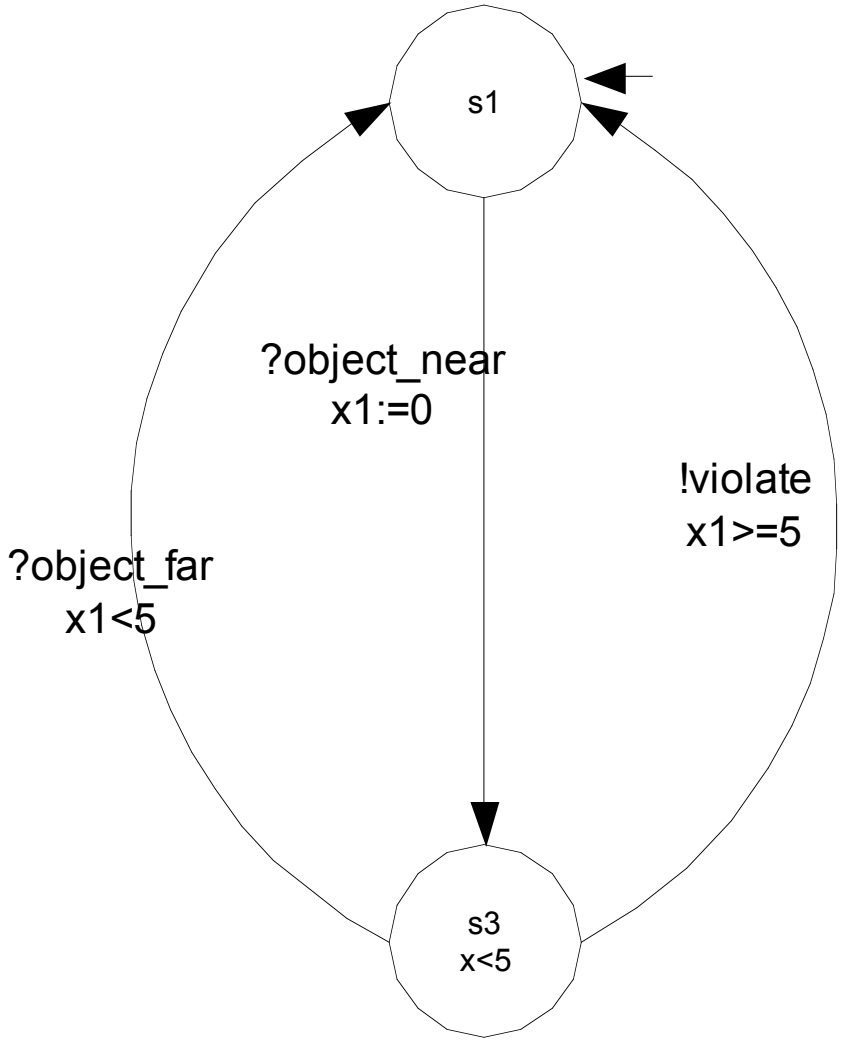


QoS behaviour



- Projection on timed transitions
- QoS violation transitions added

Giotto program

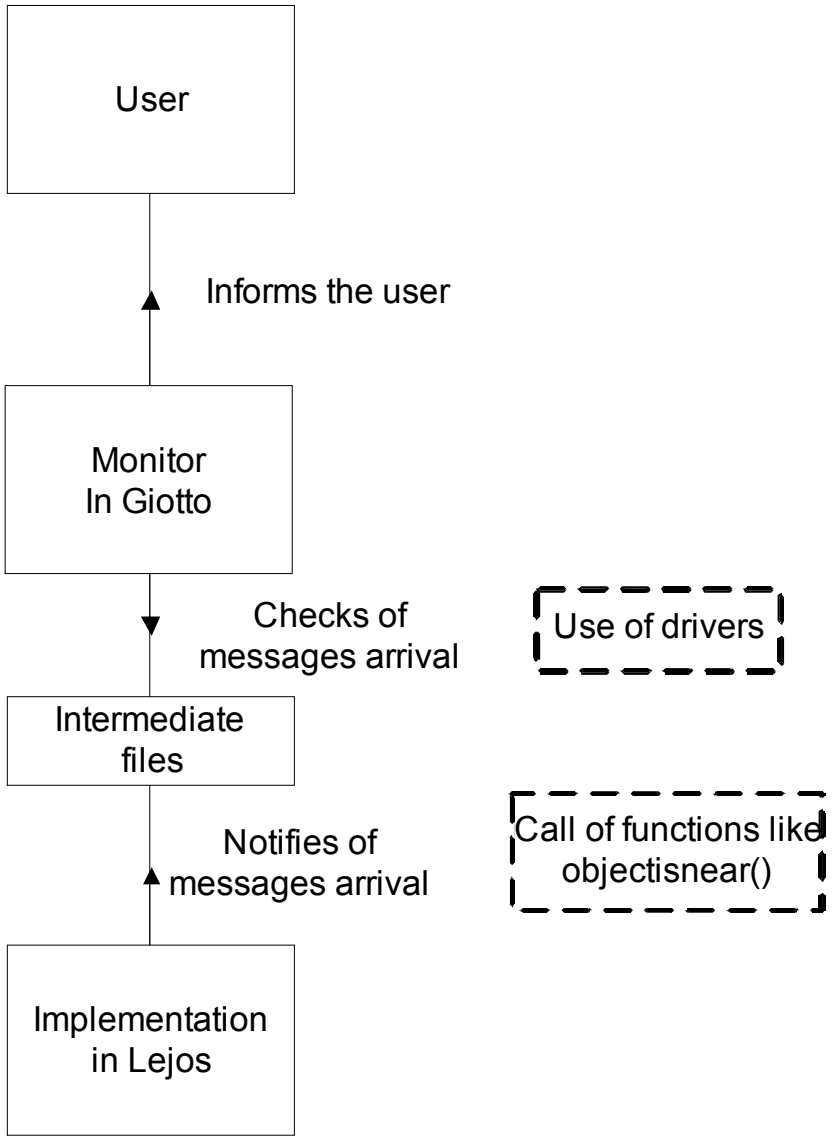



```
start s1 {
 mode s1() period 1000 {
    exitfreq 1 s3(drivers1s3near);
    taskfreq 1 do Inc();
 }
 mode s3() period 1000 {
  exitfreq 1 do s1(drivers3s1far);
  exitfreq 1 do s1(drivers3s1error);
  taskfreq 1 do Inc();
 }
}
```

Driver's code

```
public class Conds1s3near extends BaseCondition
implements ConditionInterface, Serializable {
    boolean object_near=false;
     public boolean run(Parameter parameter) {
          return object_near && X1.getValue()<5;
    }
    public void objectisnear(){
          object_near=true;
}
```

Interaction components-monitor



State of implementation

- Process implemented using model transformation (Kermeta)
- Giotto adaptations for Lego Mindstorms (file support, hashtable, switch, class loader)
- Run on Tiny JVM: *Lejos*