Implementation of Sensors using Ptolemy

Stuti V.Shah [1] ,Ekata Mehul [2]

[1] *Computer Science and Engineering Department,Nirma University,Ahmedabad,India*

[2] *ASIC Division,eInfochips Private Limited,Ahmedabad,India*

stuti.shah@einfichips.com [1] *,ekata.mehul@einfochips.com* [2]

Abstract - Based on the complexity of Wireless Sensor Networks and their large deployment requirements, it becomes essential to model the system be- fore its implementation.Wireless Sensors systems includes different types of sensors with different characteristics and real constraints such as power , energy etc.This paper mainly focuses on implementation of sensors on Ptolemy and incorporating that sensors in to user library of Ptolemy which further can be re use for modeling similar types of system. Based on the type of sensor, the methodology changes since the requirement changes.Couple of sensors which are used for health monitoring systems such as blood pressure sensor, Glucose sensor , Temperature sensor , Bed and chair occupancy sensor with primarily learning method of artificial intelligence are implemented and added to Ptolemy library,example of sen- sors which are added to Ptolemy library are glucose sensor, Temperature sensor and Blood pressure sensor.

Keywords: *Ptolemy, Sensor, Health, Monitoring Systems, Security*

1. Introduction

This paper gives reader a quick overview of how different sensors are modeled in Ptolemy. Approach adopted in this paper is couple of sensors are taken as an example for showing their interaction with Ptolemy. Implementation of the sensors is done using visual sense which is a tool for modeling wireless sensor networks on top of Ptolemy. After implementation the sensors can be added to user library of Ptolemy as example Glucose sensor, Blood pressure sensor and Temperature sensor. The sensor also gives parameters which can be configured at the time the component is dragged from library. Sensors are implemented using primary learning method of artificial intelligence which is learning from past records.

Section 1 give details on features of sensors which are implemented. Section 2 elaborates stepwise details used for implementing controlling device and different sensors,flow chart showing steps of implementation for controlling device and implemented sensors. Section 3 elaborates the way artificial intelligence and parameter configuration is incorporated in sensor implementation.

- **Features of Sensors:**

1.1 Glucose sensor,Blood Pressure Sensor, Temperature Sensor

- This sensors are working on timers
- They will have timer running on their device and when at every specified time interval it will send signal to Wall mounted device which will contain record value.
- Device should have capability to find whether value received is within range or not.
- Parameter configuration facility is require so initial value for range can be set by expert.
- The sensor should be added to Ptolemy library so then it can be directly dragged from library for reusable purpose.
- Location variable should move sensors randomly.
- Single output port will be used for sending values to controlling device

1.2 Bed and Chair Occupancy Sensor

- Used for finding whether person has gone out of bed and return within specified period of time not
- Location for this sensor is fixed.
- The sensor will have timer running on it. When person gets out of bed it will keep time details and will start timer at that time.
- If the person is back within time the timer will be stop else if time expires it will send signal to controlling device
- This will generate interrupt to controlling device as immediate action needs to be taken by controlling device

1.3 Motion Sensor

- Used to track persons movement in the room
- The sensor will continuously generate values of x,y coordinate and that signal will be sent to controlling device timely
- The controlling device will have plot functionality by which it will plot points on graph and it will use mathematical formula for finding distance traveled by person.
- If the person is back within time the timer will be stop else if time expires it will send signal to controlling device
- If the person is moving too faster or too slower that can be found out by controlling device.

2 Implementation of Sensors

Ptolemy provides large number of library components which can be used to implement sensors. The generic method followed for implementation of all the sensors is described.

Communication between Monitoring device and sensors is done with wireless channel. For implementing all the sensors discrete event director of Ptolemy is used so that can be further used under wireless director of Ptolemy for system level implementation.

2.1 Steps used for implementing Monitoring device

1. Monitoring device needs to maintain database for different sensors incom- ing records.
2. Ptolemy's Database manager library of components can be used for main- tain database. It is available with Ptolemy 8.0.1. It provides different components for interacting with sql database. It provides facility of in- serting record in to database, fetching record from database and deletion of records.
3. All the sensors implemented in this paper is having clock running on it.

   It will send timely report to Monitoring device
4. When monitoring device will receive message on input port it will read the message and it will find that from which sensor record is coming .message separator functionality can be achieved by Ptolemy distributor compo- nent.
5. For different sensors Different database will be used
6. When it receives record it will check that record against the range set with the use of primarily artificial intelligence method described in section 3. Ptolemy Boolean switch component is used for checking record against desire range
7. If record is within specified range then that record will be stored in database and if record is outside desired range then monitoring device will take action
8. The action by monitoring device can be call to doctor with help of sensing message to care taker
9. If there is some fault in sensor and if it is not working properly it will not be able to send timely record to monitoring device this will be tracked by monitoring device by running timer on it. If after certain time expires if sensor has not set any record, it will try to connect it and it will find whether it is working properly or not.

The way of implementation of monitoring device can be shown with flow chart as shown in the figure 1.Implemented Monitoring Device is shown in Figure 2.

Figure 1: Flow Chart for Implementation of Monitoring Device

2.2 Steps Used for implementing Sensors

1. All the sensors implemented here are working on clock. So the clock is generating an event at specified time interval. Different type of clocks such as triggered clock, Poisson clock, Discrete clock are available with Ptolemy. The time interval for clock can be configured according to requirement
2. Once Clock generates event at that time the sensor should generate value and send it to monitoring device
3. For generating value it will use range variable which is set by primarily artificial intelligence method described in section 3.

4. For simulation sensor node is deciding whether to generate value inside range or value which is not in range

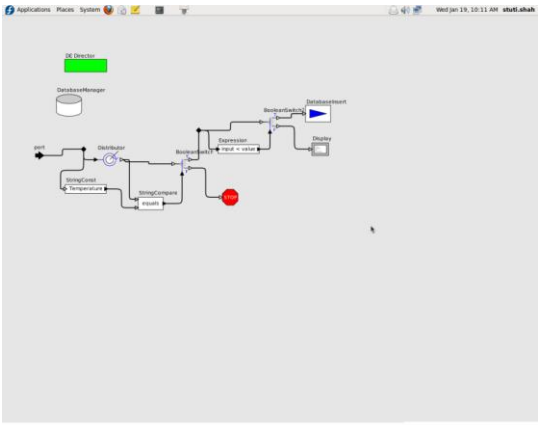

Figure 2: Implemented Monitoring Device in Ptolemy

5. Use of random number generator component is done for deciding whether to generate values inside range or not. Different types of random number generators such as Uniform,Triangle,Gaussian,Bernoulli are available with Ptolemy random library. It gives flexibility to specify range in which the numbers needs to be generated.

6. Once random number is generated it is compared with Boolean switch to find out whether to generate value inside range or value out side range.

7. Again random number component is used after taking decision to generate actual values. If value need to be generated in the range then it will take range variable values set by primary artificial intelligence method described in section III and it will set that variable for generating values else it will take the range and by some simple mathematical addition or subtraction it will take range which is not actual range parameter and generate values in that range.

8. It will form packet which includes the token identifying the sensor name so controlling device can use this token to identify from which sensor record is coming and record value which is generated by random number. Merge component will combine both record and string so the packet is formed

9. It will use out port to send that packet to controlling device. The packet is broadcasted to all nodes but packet will be used by controlling device.

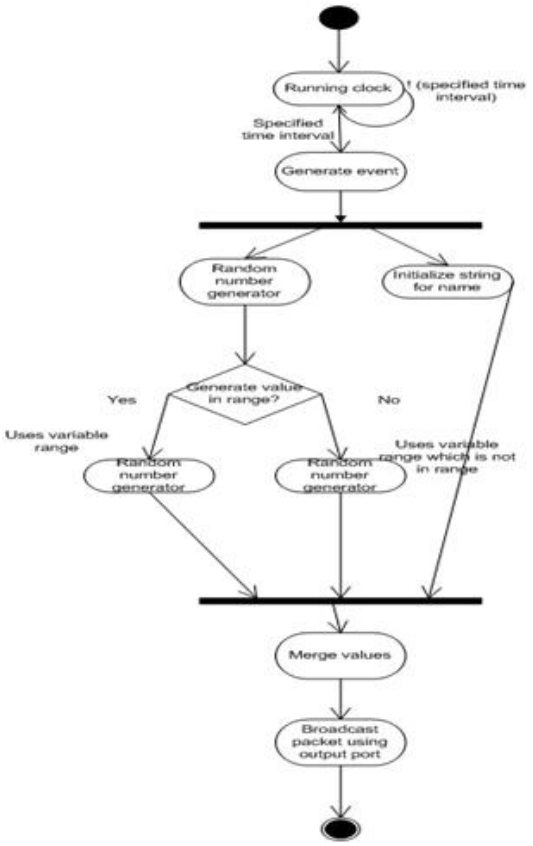

Figure 3: Flow Chart for Implementation of Sensor

The way of implementation of sensors can be shown with flow chart in figure3.

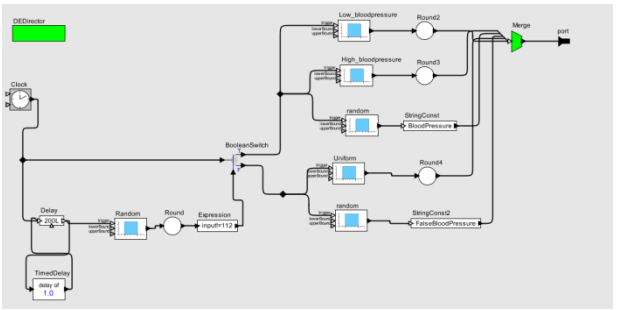

Figure 4: Sensor Implementation in Ptolemy

Figure 5: Sensor Implementation in Ptolemy

2.3 Adding Sensor to Ptolemy library

Ptolemy provides facility to add actor in user library by just simple right clicking on the model built and click on save actor into user library. Once this library is formed it will appear for every time Ptolemy graphical user interface is opened shown in the below figure.

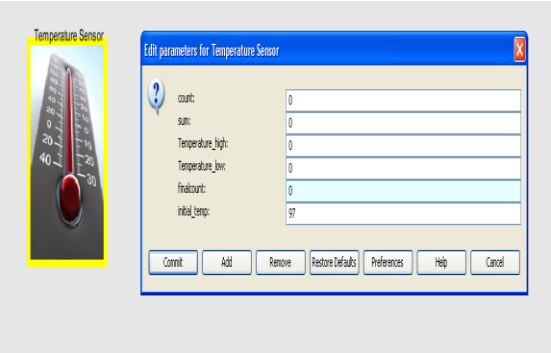

Figure 6: Sensor Added in Ptolemy Library.

3 Incorporating Artificial Intelligences Method and Flexibility in Parameter Configuration

1. For generating values the sensors are using variables that can be set by parameter.
2. Ptolemy provides way to create parameter which can be specified accord- ing to requirements and when that component is added to library or it is used again it can take values specified by user.
3. The use of parameter configuration in implementation of this sensors are for example the range of glucose level changes from person to person so that parameters can be set by doctor. So the values which are generated is in the range of that values
4. The sensors which are implemented uses primary artificial learning method which is learning from past records
5. Once initial range of glucose level is set by doctor sensor would start generating values in that specified range. The model will have one counter running on it. First ten records will be added and when count turns to eleven the average of the records are taken and it will change the range from old one set by doctor to newly calculated one.
6. This value range is broadcasted to controlling device so that controlling device can also set values according to the range values coming from in- coming port.
7. Once range parameter is calculated random number generator will use that range to generate values.

Snap shots for parameter configuration and sensor implementation with artificial intelligence is shown in figure7.

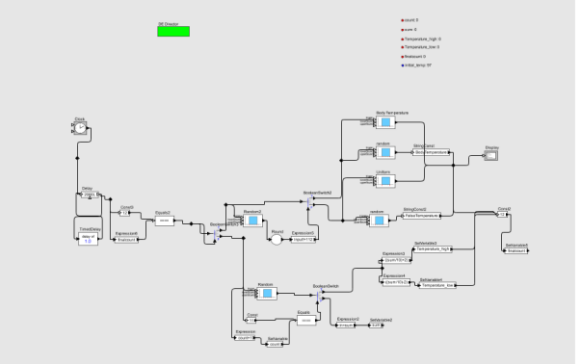

Figure 7: Implementation of Sensor Network with Artificial Intelligence

4.Conclusion

Wireless sensors implementation on Ptolemy provides a good way of realizing actual sensor implementation. It provides flexibility for configuring parameters and adding that to user library so the sensors can be re use for similar types of system. The sensors implemented in this paper are all working on clock bases and used for health monitoring systems. Similarly different sensors used for different purpose can be implemented on Ptolemy.

5.Future work

Primary artificial intelligence method for sensor implementation is used. Different learning algorithms such as neural networks, genetic algorithms can be implemented for more accurate calculation of range parameter.

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