Model-Based Monitoring for Early Warning Flood Detection

Elizabeth A. Basha

Sai Ravela

Daniela Rus

Deepak Martin

Outline

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Effect of Floods

	US	North Korea
Fatalities :	18	454 dead
Damages:	$544 million	$22.5 million
Duration:	17-24 Aug 2007	15-32 Aug 2007
Areas :	Illinois,Indiana, Iowa,Minnesota,ohio and wisconsin	Southern half

Type of flood warning system

- Developed region like US – SAC-SMA
- Volunteers based – Honduras
- Bangladesh – data from remote sensing satellites

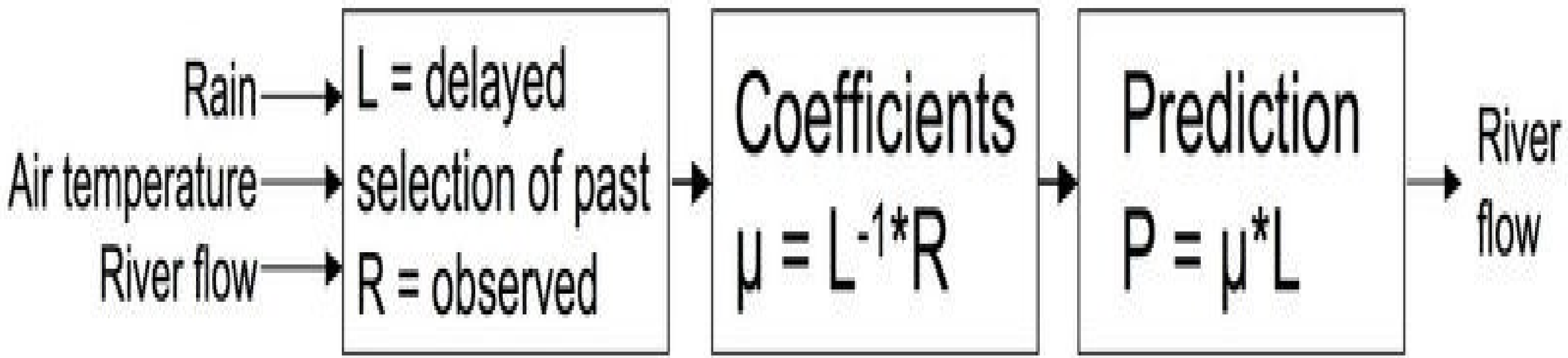
Flood Detection problem

- Event prediction
- Authority notification
- Community alert
- Community evacuation

System Requirement

- Monitor Event over large geographic regions (10,000 km2)
- Measure a wide variety of variables
- Survive long term exposure
- Recover from node loss
- Detect and predict the floods
- Withstand the floods
- Minimize costs

Block Diagram



Overall Algorithm

Calibration:

$T_{TL} = T_T - T_L;$

▷ Compute initial coefficients and prediction

$\phi_N \leftarrow [\phi(1 : T_{TL} - N), ..., \phi(1 + N : T_{TL})]$

$\theta_P \leftarrow [\theta(1 : T_{TL} - P), ..., \theta(1 + P : T_{TL})]$

$\rho_Q \leftarrow [\rho(1 : T_{TL} - Q), ..., \rho(1 + Q : T_{TL})]$

$X \leftarrow [\phi_N, \theta_P, \rho_Q]$

$C = ((X * X^T)^{-1} * X^T) * Y(1 + T_L : T_T)$

$Y(1 + T_L : T_T) = X * C$

▷ Recompute using prediction error

$e = Y(1 + T_L : T_T) - \phi(1 : T_T - T_L)$

$X \leftarrow [\phi_N, e, \theta_P, \rho_Q]$

$C = ((X * X^T)^{-1} * X^T) * Y(1 + T_L : T_T)$

$Y(1 + T_L : T_T) = X * C$

Prediction:

for $t = T_T + 1$ to ... **do** ▷ Forecast

  if $(t\%T_R) == 0$ **then**

    ▷ Recalibrate coefficients

    $e = Y(t - T_T : t) - \phi(t - T_T - T_L : t - T_L)$

    $\phi_N \leftarrow [\phi(t - T_{TL} : t - N), ..., \phi(t - T_{TL} + N : t)]$

    $\theta_P \leftarrow [\theta(t - T_{TL} : t - P), ..., \theta(t - T_{TL} + P : t)]$

    $\rho_Q \leftarrow [\rho(t - T_{TL} : t - Q), ..., \rho(t - T_{TL} + Q : t)]$

    $X \leftarrow [\phi_N, e, \theta_P, \rho_Q]$

    $C = ((X * X^T)^{-1} * X^T) * Y(t - T_T : t)$

  end if

  ▷ Compute Forecast

  $e = Y(t) - \phi(t - T_L)$

  $\phi_N \leftarrow [\phi(t - N), ..., \phi(t)]$

  $\theta_P \leftarrow [\theta(t - P), ..., \theta(t)]$

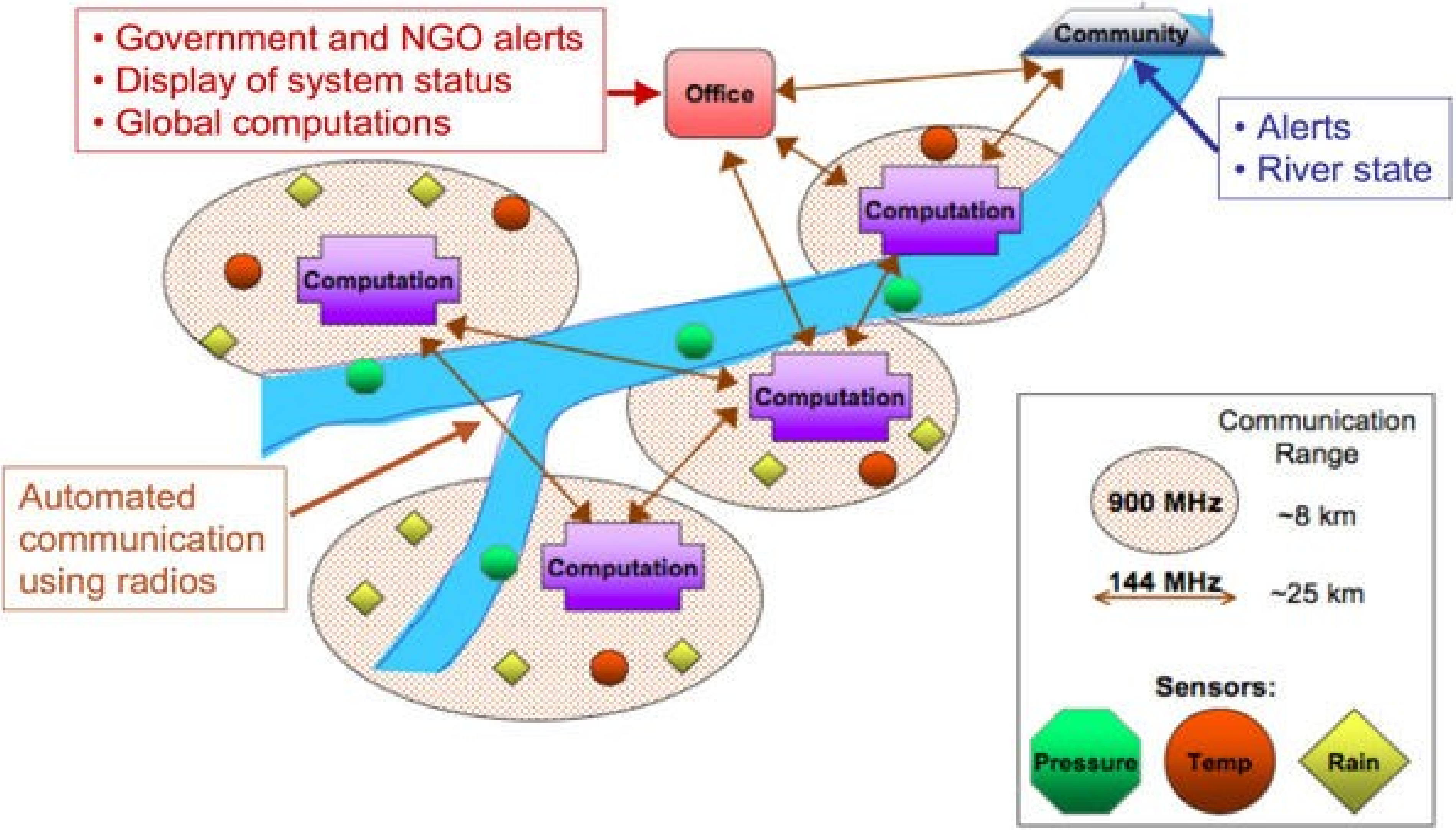
  $\rho_Q \leftarrow [\rho(t - Q), ..., \rho(t)]$

  $X \leftarrow [\phi_N, e, \theta_P, \rho_Q]$

  $Y(t + T_L) = X * C$

end for

Architecture



Architecture

- Base system
- Communication
- Sensing nodes
- Computation nodes
- Government Office Interface nodes
- Community interface nodes

Installation and results

- Blue River
- Dover Field Test
- Honduras Field Tests

Conclusion

In this paper the flood detection prolem is undestood and a solution is given which as per the research and the trails at the field test shows should be very successful. The further implementation of the project is to be carried out.