

# Quenching the Thirst of Jhelum: Internet of Things Based Smart City Perspective

Sahil Sholla

Research Scholar, Dept. of CSE,  
National Institute of Technology, Srinagar

Roohie Naaz

Professor, Dept. of CSE,  
National Institute of Technology, Srinagar

Mohammad Ahsan Chishty

Asst. Prof., Dept. of CSE,  
National Institute of Technology, Srinagar

## Introduction

If there be paradise on earth, it is here, it is here, it is here: meaning Kashmir! Indeed, Kashmir is known world over for its scenic beauty and many people throughout the world yearn to visit it at least once in their lifetime! However, due to environmental negligence, the paradise is in peril.

The primary river body that traverse the valley of Kashmir is Jhelum. Commonly known as 'Vyeth' in Kashmiri language, it originates from a spring at Verinag, which is at the foot of Pir-Panjal mountain range in the south-eastern part of Kashmir Valley. It flows through a long stretch of 185 km across the valley and then passing through Baramulla and Uri finally enters into Pakistan. The river passes through the heritage city of Srinagar with habitations along the banks of the river on both sides. The nine bridges over the river, which were built years ago, serve as hot spots of tourism in this historic city. Many hydro power projects which generate electricity are constructed on this river e.g. Kishenganga, Uri etc. Eulogised for its beauty and a vital source of hydropower and irrigation, the Jhelum plays a significant role in the socio-economic fabric of the Kashmir valley in northern India. In order to preserve

the beauty of this river it is of utmost importance to take effective measures for restoring its pristine glory.

Jhelum has historically been the fountain of life for areas surrounding it but people are guilty of feeding it with poison. The river that quenched thirst of millions over centuries is now dying due to indifference of the very people it nourished. Rapid urbanization facilitated by technological advances has made people indifferent to nature but technology if used properly could address the pressing issues of environmental degradation. There is an urgent need to preserve the natural environment of river Jhelum from pollution and encroachment. A new approach to networking called Internet of Things (IoT) could actually provide plausible means to quench the thirst of Jhelum.

Networking technology has evolved from connecting computers using internet, to connecting mobile phones, PDAs (Personal Digital Assistant) and various gadgets that have some communication ability. This novel approach in networking to connect virtually all things due to the advent of low cost sensor and communication technologies is known as Internet of Things. All things of everyday use like house hold appliances, machines, vehicles, buildings

etc. could be embedded with sensors along with necessary communication capability to realise the vision of Internet of things. Such technology holds immense potential to revolutionise many aspects of human life like healthcare, transportation, agriculture, industry, building and environmental monitoring - land, air and water. This all-encompassing change is poised to revolutionise our cities into what are known as smart cities.

For environmental monitoring Internet of things uses a large number of embedded sensors to monitor parameters of interest in real time, perform aggregation and processing of such data to provide valuable insights into the dynamics of environmental health and guide possible remedial measures. Given the capability of IoT to facilitate environmental monitoring, it could be effectively used to monitor and control pollution of river Jhelum. Smart city vision driven by IoT could also pave the way in addressing other key concerns like dredging and flood alert.

## Pollution

Rapid urbanisation, increased vehicular traffic, direct or indirect dumping of solid and liquid waste, unabated use of fertilizers and pesticides particularly in last few decades has lead to the choking of river Jhelum. The concentration of various parameters like conductivity, pH, chlorides, nitrates and free CO<sub>2</sub> have passed the permissible limits prescribed by WHO<sup>[1]</sup>.

Sensors monitoring various chemicals in water could be embedded on the banks of Jhelum or the river bed to provide real time monitoring of the river. The data from the sensors could be relayed to nearby sink possessing more computational resources for the aggregation of data. The data from various sensors could then be processed on the cloud using data mining to reveal valuable information about various pollution parameters like which areas of the river are more severely affected, trends of



Fig. 1: River Jhelum in Srinagar



Fig. 2: Polluted Jhelum<sup>[2]</sup>

pollution over the years, percentage of various foreign bodies in the water etc. This would provide valuable insight into the health of Jhelum in real time possibly using a mobile application.

Appropriate surveillance mechanisms could also be used to address the plague of massive encroachments along the banks of Jhelum and take punitive action against the offender. Apart from monitoring pollution, IoT paradigm could also be used to actuate appropriate procedures to prevent and control pollution. For example, spraying of necessary chemicals could be triggered if a particular impurity crosses a recommended threshold. If the smart city paradigm is fully adopted for Srinagar city, various pollutants could be traced for their place of origin, person responsible for violation and necessary disciplinary action against the offender could also be executed.

#### Dredging

Massive soil erosion caused due to the rapid deforestation has only exacerbated the situation due to accumulation of silt in the river beds to such an extent that it has drastically reduced the carrying capacity of Jhelum. IoT vision could help alleviate this problem by using sensors embedded in the river bed or along the banks to monitor depth of the river bed at key locations. If particular threshold is reached, appropriate warning messages could be relayed to authorities to take necessary action. Suitable infrastructure

could also be installed at strategic points so that necessary dredging measures are actuated with minimum human intervention via device to device communication. Such measures would ensure sufficient carrying capacity of Jhelum to prevent surrounding areas from submerging and subsequent loss to human life and property in the event of increased water level.

#### Flood Alert

Flood management is one of the most challenging aspects once the water level has crossed the danger mark. The devastation caused by September 2014 floods must serve as an eye opener

not only for the administration but for common citizens also. Even when necessary measures are taken against pollution and encroachment, there could still be instances when flood occurs.

Table 1 shows key locations designated by Irrigation and Flood Control department for sounding flood alerts and respective water level threshold that indicates threat level<sup>[4]</sup>. Using the IoT paradigm sensors could be placed throughout the stretch of Jhelum for monitoring water level particularly at pivotal locations like Sangam in South Kashmir, Ram Munshibagh in Srinagar and Asham in North Kashmir.

When water crosses the threshold, alerts could be broadcast to warn the management and local population about possible flood eventuality so that evacuation procedures are initiated and preventive measures taken. Evacuation maps, procedures, precautions and self-help steps could be displayed in public advertisement boards or smart devices like smart phones, smart watches, smart TVs in the vicinity of looming flood situation to facilitate evacuation.

Key backbone nodes could be identified in each city at strategic locations so that even in case of breakdown of normal communication channels, communication among them is ensured using more robust links like wireless communication. Disaster management procedures like dumping of construction material to increase bund height, self healing of bund and diversion of water in case of flood could also be actuated using device to device communication with minimum human involvement.



Fig. 3: Dredging work in progress along river Jhelum<sup>[3]</sup>



Fig. 4: Jhelum submerged banks

A smart city may not be able to prevent a flood when it actually occurs but by keeping authorities and people informed about the situation in real time, loss to life and property can be minimized.

#### Conclusion

River Jhelum represents the lifeline of Srinagar city due to its importance for city's transportation, irrigation, tourism, ecology

and environment. However, in the past few decades, the river has greatly suffered due to lack of attention from administration and common people. Pollution of the river has lead to destroying natural environment, causing damage to its flora and fauna and decreased capacity of Jhelum to hold water that could lead to floods during times of increased water level. In this article, we have

proposed using the smart city paradigm driven by IoT to address issues of pollution, dredging and flood control in order to alleviate the problems of river Jhelum.

An array of sensors would be used across the stretch of Jhelum to monitor parameters of interest, perform data analytics to provide valuable insight into the environmental dynamics of river Jhelum and steer potential remedial methods. Sensors measuring various water quality parameters in real time would keep municipal authorities updated anywhere in the world to ensure pollution free Jhelum. Information gathered by sensors measuring depth of river bed could help authorities decide on the need of dredging or necessary procedures could also be actuated without human intervention. Flood alert mechanisms were also suggested to facilitate evacuation and minimize loss to life and property. By recourse to such measures we hope to restore the pristine glory of river Jhelum.

#### References

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Site	Gauge level (ft)		
	Flood Alarm	Flood Declaration	Danger Level
Sangam (Anantnag)	18	21	23
Ram Munshibagh (Srinagar)	16	18	19
Asham (Bandipora)	13	14	15

Table 1: Key locations for flood threat along river Jhelum

#### About the Authors



**Mr. Sahil Sholla** is pursuing his Ph.D. at the Dept. of CSE, National Institute of Technology Srinagar, India. His research focuses on 5G mobile and wireless communication, Internet of Things and security. He can be reached at: sahilsholla@gmail.com.



**Dr. Roohie Naaz Mir** is a Professor in the Dept. of CSE at NIT Srinagar, India. She is a Fellow of IEI and IETE India. She is the author of many scientific publications in international journals and conferences. Her current research interests include reconfigurable computing and architecture, mobile and pervasive computing, security and routing in wireless adhoc and sensor networks.



**Dr. Mohammad Ahsan Chishti** [CSI - I1501576] is working as Assistant Professor and Head of the Dept. of CSE, NIT Srinagar. He has more than 50 research publications to his credit and 8 patents with two granted International Patents. He has been awarded "IEI Young Engineers Award 2015-2016" in the field of Computer Engineering and "Young Scientist Award 2009-2010" from Department of Science & Technology, Government of J&K.