

# IoT-Cloud Applications for Societal Benefits – An Entrepreneurial Solution



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## **Abstract**

High end technologies such as Cloud, Edge, Fog computing, and so forth have profound implications on addressing the emerging issues of societies. Several leading societal problems such as air pollution, water pollution, corruption, and poverty could be timely notified or addressed with the application of these high end technologies. This article discussed a few societal applications and the importance of an IoT Cloud enabled technologies. In addition, the current research works and the innovative product developments at the IoT Cloud research lab of the Indian Institute of Information Technology Kottayam were discussed.

## **IoT Cloud Technologies – An Introduction:**

Internet of Things is a system where hundreds or thousands of devices/sensors could communicate each other over internet in an automated fashion for attaining certain tasks. Several researchers, business enthusiasts, and entrepreneurs have attempted to develop applications relating to societal innovations using IoT technology. In fact, Cisco has estimated that the technology would generate a revenue of \$14 trillion by 2020; DST-India has formulated an initiative for developing IoT based solutions or products; Atal Nidhi Aayog's AIM scheme has encouraged business models with innovative technologies such as IoT, Cloud, and so forth.

In fact, most of the researchers', including industrialists, have engaged cloud based databases and cloud-enabled solutions for their applications. This is due to the fact that the sensors need not require large volume of memory or processing power. Obviously, hosting such a large amount of data in cloud constantly lead to the networking and memory issues for most of the societal applications. For instances, weather prediction or automation industries could transport sensory data in the range of over terra bytes to the cloud.

Recently, technologies such as Edge computing has provided a feasible solution to IoT Cloud application developers. By this, limited data are forwarded rather than dumping all sensory data to the cloud database. This means that the data are screened in with some pre-defined criteria before they would be uploaded to the cloud.

As cloud technology provide pay-as-you-go computing model, startups and incubates could venture upon their innovations at the minimal costs. The technology could also offer tens of thousands of innovations when married with societal products. This article discussed the societal applications and the need for high end technologies, most importantly, the IoTCloud.

## **Societal Applications – Domains:**

Societal applications exist in various disciplines – agricultural, forestry, pollution, chemical engineering, forensic, ICT domains, and so forth.

The emerging societal applications could be classified in the following categories:

Smart living at home

Smart living at society

Smart environment

Smart agriculture

Smart Health

*Figure 1 Societal Applications - Category*

i) Smart living at home

People, mostly living in urban cities, anticipates a smart living. This means that their wearable devices should be remotely connected and synchronized in a way such that the solutions should seamlessly assist them to pursue their daily routines with ease. For instances, the evolving solutions have predominantly attracted people to enhance their home with security gadgets and fire/flood/tsunami alarm machines; refrigerators do communicate with the personal mobile devices to remind them about shopping milk tonight.

ii) Smart living at society

Society should be automated so that the future may remain socially and economically competitive. The current issues of finding a shopping mall, identifying the concerned officer to report a problem, solving apartment complexities, and so forth could be easily addressed with the help of these applications.

iii) Smart environment

Environment should be clean. What steps do we technocrats adopt for ensuring cleanliness? The Indian government, through its Swatch Bharath mission, has taken various strides to develop a Clean India. Despite several initiations, Frontline (Feb.16 2018 issue) has reported a scenario where industries dump chemical wastes to Noyyal river of Tamilnadu. Why precautionary measures are not being adopted? Can't technologies assist the concerned governmental agencies? These questions should be seriously dealt with for the future Clean India. In addition, air pollution is also remaining as a serious concern in various parts of India, which results in health hazards to the society.

iv) Smart Agriculture

Optimizing watering at agricultural lands could increase the economy of the society – i.e., the farmers at large. Weather assisted farming with computing solutions do a tremendous role in boosting up the economy of the society. In addition, a few agriculture-suggestive ICT or alarming systems while ruining agricultural fields could be developed using these technologies.

v) Smart Health

Above 40, most of the south Indian citizens are prone to several health issues – most predominantly, the diabetes mellitus. A healthy society is a productive society. Patient monitoring and health monitoring machines should be produced in a cost effective manner for the utilization of any common man.

### **Benefits/Challenges of IoT-Cloud for Societal Applications**

The benefits of including IoT cloud based technologies for societal applications are manifold:

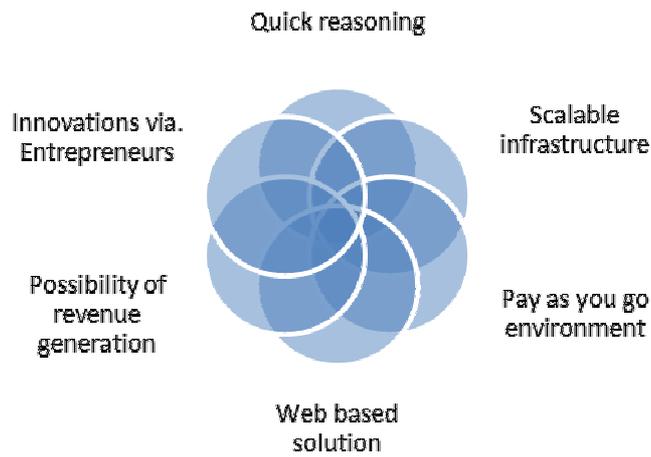


Figure 2 Benefits of IoT Cloud Technologies for Societal Applications

*Known Challenges.*

The emerging challenges while adopting IoT Cloud technologies for solving societal problems include:

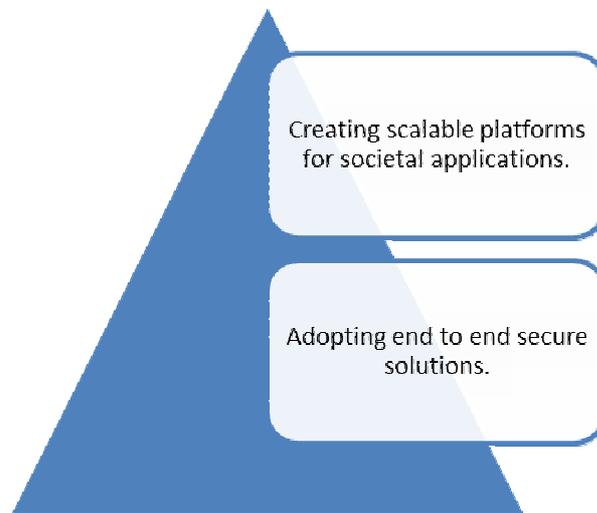


Figure 3 Challenges of Adopting IoT Cloud to Societal Problems

**Air Pollution Analysis and Ongoing Research/Innovations**

*A Case Study:* Are you planning for a comfortable living? an air-pollution free city? Is your environment safe for the family members? Is your environment safe to launch an industry or a startup company? Air quality sensors could be housed in various locations and the air quality parameters such as SO<sub>2</sub>, NO<sub>2</sub>, RSPM, and so forth could be monitored. In addition, the other weather related sensors such as temperature, moisture, air pressure, and so forth could be utilized to assist in analyzing the air quality of a particular city.

In fact, air pollution forecasting is an approach for predicting the air quality parameters in order to study the impact of air quality at a particular location or city. The forecasting could easily provide us the concentration of these air quality parameters which could guide the entrepreneurs or societal enthusiasts. A few machine learning approaches could be adopted to forecast these air quality parameters.

*Ongoing Research/Entrepreneurship at IITK:* At IITK, we are developing and motivating students (the future entrepreneurs) to develop societal applications with the help of high end technologies such as Cloud, Edge and Fog computing. For instances, Dr. Shajulin Benedict of IITK has developed a cloud microservice application to predict the air quality of cities using Random Forest algorithm. The developed solution could also create revenue to city authorities if implemented. A few of his students are developing societal applications such as revenue assisted manhole detection

(Manikayla Rao), revenue oriented water quality analysis and air quality analysis (Harsh Kumar Singh and Anuj Bhatla), and electricity consumption management system (Ravi Verma) and Water management system for smart cities (Srija M.) as part of their academic projects / internships. In fact, IITK organizes a collaborative cloud computing course along with the Technical University Munich Germany for its students to enrich the technology orienting towards the societal benefits.

Reference:

1. [ieeexplore.ieee.org/iel7/8119306/8125802/08125879.pdf](http://ieeexplore.ieee.org/iel7/8119306/8125802/08125879.pdf)

#### About the author

SHAJULIN BENEDICT graduated in 2001 from Manonmaniam Sunderanar University, India, with Distinction. In 2004, he received M.E Degree in Digital Communication and Computer Networking from A.K.C.E, Anna University-Chennai. He is the University second rank holder for his masters. He did his Ph.D degree in the area of Grid scheduling under Anna University, Chennai (Supervisor - Dr. V. Vasudevan, Director, Software Technologies Group of TIFAC Core in Network Engineering). He was affiliated towards the same group and published more papers in Int. Journals. After his Ph.D award, he joined a research team in Germany to pursue PostDoctorate under the guidance of Prof. Gerndt. He has completed two funded projects from DST and two grants from CIM-GIZ Germany while working as Professor at SXCCE Research Centre of Anna University-Chennai. He visited TUM Germany for teaching Cloud Computing as Guest Professor of TUM-Germany. Now, he works at the Indian Institute of Information Technology Kottayam, Kerala, India, an institute of national importance of India, under MHRD (PPP). His research interests include Grid scheduling, Performance Analysis of parallel applications (including exa-scale), IoT-Cloud Computing, and so forth - [www.iitkottayam.ac.in/shajulin.php](http://www.iitkottayam.ac.in/shajulin.php)

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### How English and Englishmen make fun of each other

Q: Can February March?

A: No. But April May!

Q: Did you hear about the painter who was hospitalised?

A: Reports say it was due to too many strokes!

Q: Have you heard the joke about the butter?

A: I better not tell you, it might spread!

Q: How do you know that carrots are good for your eyesight?

A: Have you ever seen a rabbit wearing glasses?

Q: Music Teacher: What's your favourite musical instrument?

A: Kid: The lunch bell!

Q: What did the triangle say to the circle?

A: You're pointless!

Q: What do you call a ghosts mom and dad?

A: Transparents!

Q: What do you call a group of men waiting for a haircut?

A: A Barbercuel!

Q: What do you call a person that chops up cereal

A: A cereal killer!