

# IoT Based Solutions for Health Care Applications

A Tata Elxsi Perspective

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# Abstract

The growing prominence of health care devices that connect to the smartphone and eventually to the cloud has opened up an unprecedented range of possibilities in the domain of health care. The growing population of people in the higher age brackets across all geographies has opened up a whole lot of challenges. The rising costs of medical care and the poor ratio of doctor to patient means that doctors are now available only to address medical requirements that urgently need their direct intervention.

The growth in diseases like diabetes especially Type2 diabetes and heart and renal ailments requires continuous patient monitoring systems that are often outside of the hospital precincts.

The technology wave generated by IoT and related technologies presents a new range of possibilities that makes this possible. There are some key considerations to be applied when the sensors, smartphone and cloud converge in this context.

This white paper discusses some of the key careabouts that one needs to bear in mind in architecting, designing, development, testing, certification and deployment of such products.

The paper concludes with Tata Elxsi's offerings in the Digital Services- IoT space and how they can be best leveraged by health care equipment manufacturers and tele health companies to conceive, design, develop and deploy innovative IoT enabled cloud based products.

## Introduction

The growing prominence of health care devices that connect to the smartphone and eventually to the cloud has opened up an unprecedented range of possibilities in the domain of health care. Advances in medicine has drastically improved the health expectancy levels. This has resulted in an ever increasing percentage of people in the older age groups in most countries of the world. At the same time, the availability of care givers is on the decline and therefore those that are entrusted with these responsibilities subject to a huge amount of stress. Governments are now struggling with the problem to being able to provide the right kind of medical care to their ageing population and the rising costs thereof. This scenario has opened up a whole lot of possibilities from a business perspective.

The growth in diseases like diabetes especially Type2 diabetes requires a high level of monitoring and control which can often be best addressed by the patient or the tertiary health care personnel who are accessible to the patient at all times. This is also the case for aspects like hydration levels that are vital in post operative scenarios and in renal ailments.

The global telecare and telehealth market is forecast to grow to 21.3 billion by 2016. Companies are now investing in large measure to make fully well of this potential. The government

spend on health care and related markets is also on the rise across all geographies.

In most cases, the primary care about from a remote health care perspective is to ensure that the role of a primary care giver can be replaced with a series of sensors and devices that can monitor the state of health of an elderly person. Providing round the clock health care can be a very tiring and arduous task often taxing the health and well being of the care giver. With a large series of sensors and devices and with the advent of Internet of Things (IoT) and a host of digital services applications, it is now possible to have deploy a cost effective infrastructure that will oversee the vital parameters of the patient on a continuous basis. This can enable care givers to avoid needless fatigue and be confident that they can intervene when the situation so demands.

IoT also enables the Cloud based systems to study various operating conditions of the patient round the clock and provide necessary alerts and interventions at near real time. It is also possible through the use of advanced analytics to understand the decline in health status of patients and to enable timely interventions.

In all these cases, time is of essence and the delays in rushing medical help can often result in fatalities or life changing situations and this is best avoided by a series of notifications given to the physician, ambulance networks, paramedics or care givers as the case may be.

There are also scenarios like in Diabetes management for the patient themselves to have a continuous awareness of their state of health and provide them the necessary alerts to do the necessary interventions either clinically through devices like insulin pumps or at a basic level to manage dietary intake to regulate blood glucose levels.

This paper describes the careabouts and challenges associated with developing IoT enabled systems that continuously monitor the state of health of individuals and prompt the right interventions.

## Smartphone App

The smartphone which became an advanced version of the cell phone whose intention was to establish calls and send messages is now being widely used as the consolidated device to deliver a first level intervention of the medical requirements of the patients. One of the first level challenges is to ensure that the transmit device that is either an implanted device or a wearable has a seamless connectivity at all times to the smartphone or the WiFi gateway as the case may be. Often one of the connectivity technologies like BT or even better BTLE becomes the backbone of the connectivity, made attractive by the low power consumption. However, the one needs to ensure the connectivity and the possibility that the transmit device on the patient may not at all times be near the patients smartphone presents challenges. The availability of backup

mechanisms like WiFi can be a viable alternative though this would push up the costs the transmitter device. The other challenge in this case is the fact that ensuring that the wireless connectivity is ensured is also arduous. In any case, it is critical that the smartphone alerts the user when the transmit device is out of range. This can be done as a combination of visual cues and audio cues like beep.

It is important bear in mind that this app is a health related app whose functionality is one with far reaching and sometimes life changing consequences. It is important that this app has the maximum priority in the large number of multi threaded apps that would be running on the smartphone at any point of time.

It is also important that wherever possible the app has the ability to run on the phone in the background mode.

While reliability is a key concern it is also equally important to address the needs of privacy of the sensitive information like patient details and their health paramets.

The most important that the design of the app bears in mind from all aspects of form and function design, more commonly known as UX/UI. The age profiles and functional needs of the patients must be borne in mind at the time of UX/UI design.

It is important for the app to have the necessary permissions to locate the position of the person since it may be needed for the health care personnel or

the primary care giver to the reach a patient in distress.

An important care about is the levels of redundancies that are planned as part of the system design. Since the smartphone is often used for a large number of other power hungry applications, it is possible that the power levels of the smartphones may be quite unreliable. It is important to have sufficient fall back options that can ensure patient information is not lost.

It is important that there are a number of alert mechanisms to ensure corrective action at the earliest.

The design needs to be designed as power hungry at all stages from the sensors to the app.

Some of the other considerations are the following.

- Ensuring that the app has high priority on the phone OS
- Ensuring that connectivity issues are adequately monitored
- Sufficient buffering at the device transmit level to ensure that loss of connectivity is addressed adequately
- Checksums and other mechanisms are in place to ensure data accuracy
- Challenges of multi stage pipeline between the transmit device, smartphone and cloud
- Patient privacy and security
- Ensuring timely action is initiated in all cases without fail
- UX/UI design to suite various user profiles

- Local compliance requirements
- Fall back mechanisms to be able to monitor aspects like drug delivery
- Options to enter specific inputs from the patient like dietary plans or fluid intake on a regular basis

## Cloud Considerations

The privacy of data is one of the key careabouts in the design of the cloud components. While mechanisms like user authentication can provide a much needed first level of security they need to be backed up high level of security infrastructure at the smartphone and the cloud level.

The protocol that is used to authenticate and establish connectivity from the smartphone to the cloud must preferably be able to establish a secure channel of communication including session ID keys issued by the server. This will ensure with a high degree of reliability that the data pipe is highly secure and that the data cannot be accessed in any form. It is equally important to have encryption of the data done at the smartphone as well as at the server level. The encryption keys of such systems is best entrusted with the patients as they are the most likely guardians of this sensitive information. The right levels of encryption needs to be done to ensure that none of this impacts the system level functional response requirements.

The server needs to back up the security mechanisms in all ways

including ensuring that the user data is made anonymous at the time of data storage.

A quick summary of the key considerations from the Cloud level would include the following aspects.

- Secure pipeline to ensure that the cloud is secure from hacking
- Data redundancy and management for prolonged periods
- Response time to ensure timely action
- Multi-mode response provisioning – like primary care giver, doctor, user, by stander based on nature of alert. Smart phones, sms and conventional POTS line.
- The right sim management layer design in systems with telecom connectivity like GSM/GPRS.
- Encryption of data before database entry
- Secure authentication mechanisms
- Securing the channel through protocols like HTTPS
- Analytics engines at the backend to predict critical scenarios and profile patient health conditions.
- Analytics engines to map overall profiles or a specific group of individuals.
- Ability to map dietary information with the sugar levels to manage or hydration levels based on fluid intake.
- Billing and Monetary management
- Reporting and dash board generation
- Console management options to ensure system uptime

## Conclusion

Tata Elxsi's advanced platform build on HADOOP has been designed bearing in mind all of these considerations. The ability to defines roles and responsibilities at run time means that the system architecture can be tailored very easily to meet the needs of various geographies. The analytics engines and the ability to query the database at near run time means that the server can respond to critical needs without any undo delays. This is in addition to aspects like true multitenancy, plug and play models, transaction management, distributed persistence, cached data and role based security.

Our customers have the unique advantage of having a design partner who has the proven expertise to address all aspects of an IoT based project implementation from sensor and gateway implementation at the board or silicon level, embedded software and firmware, cloud and analytics integration, application of apps for various smartphone operating systems along with the form and function design elements to meet the needs of the target users.

## About the Author

RR, Bipin heads the Digital Service – IoT business at Tata Elxsi.

As the head of the Digital Services business at Tata Elxsi, Bipin continuously maps out the customers needs in a comprehensive manner and then brings in the right kind of technology and resources to fully address the need. Bipin has the strong conviction that real time deployments of IoT are best suited to those scenarios where there is a significant impact on customer safety and wellness. For business he believes that it is imperative to have a significant measurable business outcome.

During his career spanning over 19 years, Bipin has successfully conceived and delivered large technology projects to a global customer base in the areas of automotive, consumer, medical and semiconductor.

Bipin believes that at a very fundamental level Digital Services and IoT has the potential to address challenges faced by the ever changing social and economic landscape on a global scale.

Bipin is a well acknowledged speaker in various global forums on topics related to trends and developments in engineering and technology.

Bipin holds a Master in Microelectronics and his graduate degree in Electronics and Communication.

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## About Tata Elxsi's Digital Services offerings

Tata Elxsi's Digital Services – IoT services focus on the areas of Smart Sensors, M2M, Cloud, Analytics and Mobility. The convergence of these technologies presents a new paradigm in the way products and services are conceived and delivered to a global customer base. Tata Elxsi's offerings leverage our cloud platform that can reduce the time to market for our customers and to produce measurable business outcomes.

The customers of the Digital Services of Tata Elxsi get to benefit from the rich experience of the Industrial Design Team, the largest such in Asia.

The Digital – IoT services of Tata Elxsi leverages the deep domain expertise of the organization in the areas of communication, medical, automotive and broadcast.

## About Tata Elxsi

Tata Elxsi is a design company that blends technology, creativity and engineering to help customers transform ideas into world-class products and solutions.

A part of the \$100 billion Tata group, Tata Elxsi addresses the communications, consumer products, defence, health care, media & entertainment, semiconductor and transportation sectors. This is supported by a network of design studios, development centers and offices worldwide. Key services include embedded product design, industrial design, animation & visual effects and systems integration. Tata Elxsi is a listed company and headquartered in Bangalore, India.

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