International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 08 | Aug 2018 www.irjet.net p-ISSN: 2395-0072

Comparison on Implementation Models of Smart Applications Using IoT Technology

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Abstract- The perception of IoT signifies the advancement of the Internet and its appliance is persistently developing. Conferring to assessments, by means of this concept 50 billion devices will be associated by 2020 which places heavy demands and challenges in preserving the mandatory safety level of such an environment. This paper is focused mainly on the different technologies used by IoT in latest trend by projecting them from various aspects and perspectives. The comparison shows the clear view on different aspects like Technical environment, Application mode, Management system, Realtime Notification for the chosen smart applications of IoT. This way we can easily understand the technology used for various applications.

Key Words- IoT, Realtime Notification, Isolated System, Sensor Ability, Interoperability.

I. INTRODUCTION

IoT (Internet of Things) is the network of physical objects-devices, vehicles, buildings and other items set in with electronics, software, sensors, and network connectivity that facilitate these objects to sense, collect, exchange data and control remotely across existing network infrastructure that is based on a layered architecture. Each of the layers includes the application of a range of diverse technologies for the data transmission, processing and storage[1]. The vulnerabilities and threats in IoT environment and protection methods can be implemented within environment due to the hardware limitations of the existing equipment and technology used for data transfer. The rapid development of information technology has brought advancing a hyper connected society in which objects are connected to mobile devices and the Internet and communicate with one another. In the 21st century, we want to be associated with anything anytime and anywhere, which is already up-to-the-minute in various places everywhere in the world. The core component of this hyper connected society is IoT, which is also referred to as Machine to Machine (M2M) communication or Internet of Everything (IoE).

Fig-1: Anything Anytime and Anywhere-IoT

Over 12.5 billion devices were already connected in 2010 and about 50 billion devices will be connected by 2020. However, little is known about the impacts of IoT service to consumer behavior. From the consumer point of view, IoT is both opportunity and possible danger[3]. Given the importance of understanding consumer for successful IoT service spread in the market, it is critical to research major factors and dynamics affecting IoT consumer attitude. Internet of Things (IoT), triggered by technological advances in embedded systems hardware, software, and connectivity. The increasing availability of tiny, cheap, power-efficient micro-controllers and peripherals has spun a new category of computers: low-end IoT devices. Even though such devices cannot run traditional operating systems (e.g. Linux and equivalents) due to very constrained memory, CPU, power resources, most low-end IoT devices have enough resources to run newer operating systems and cross-platform application code. Furthermore, recent network technology and protocol standardization efforts have enabled new interconnection capabilities for such devices, such as low-power, end-to-end IPv6 based networking. The growing role of the Internet of Things (IoT) concept is proved by its application in the number of areas such as the development of smart cities, the management of energy resources and networks, mobility, transport, logistics, etc. The high level of complexity of the IoT concept and the use of Automatic Identification and Data Capture (AIDC) technologies increases the risk of compromising the basic principles of safety which is why this problem domain remains continuously investigated in the last few years.

II. LITERATURE SURVEY

The number of IoT devices increased 31% year-over-year to 8.4 billion in 2017 and it is estimated that there will be 30 billion devices by 2020. The global market value of IoT is projected to reach $7.1 trillion by 2020. IoT involves extending internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of usually dumb or non-internet-enabled physical devices and everyday objects[2]. Fixed with technology, these devices can interconnect and cooperate over the internet, and they can be remotely examined and precised. The following are the IoT Protocols broken into the following layers to provide some level of organization to fit all of the IoT Protocols on top of existing architecture models like OSI Model, Multi-layer Frameworks (ex: Alljoyn, IoTivity, Weave, Homekit)[4].

1. Infrastructure (ex: 6LowPAN, IPv4/IPv6, RPL)
2. Identification (ex: EPC, uCode, IPv6, URIs)
3. Comms/Transport (ex:Wifi,Bluetooth, LPWAN)
4. Discovery (ex: Physical Web, mDNS, DNS-SD)
5. Data Protocols (ex: MQTT, CoAP, AMQP,

   Websocket, Node)
6. Device Management (ex: TR-069, OMA-DM)
7. Semantic (ex: JSON-LD, Web Thing Model)

From the consumer point of view, IoT is both opportunity and possible danger. Specified the prominence of accepting consumer for positive IoT service spread in the market, it is critical to research main issues and dynamics affecting IoT consumer attitude. Among the researchers, Mick and Fournier are the first researchers who paid attention in examining the role of technology contradictions again within the context of SST (self-service technology), and divided the various contradictory attitudes into two main categories. Based on the analysis of survey data, they projected the concept of satisfiers and dissatisfiers. Satisfiers are positive drivers of technology use and dissatisfiers are negative drivers[8]. Their research revealed further that satisfiers of technology has durable interactions with consumer satisfaction, while dissatisfier has negative possessions.

IoT Protocols:

Bluetooth: An significant short-range communications technology is of course Bluetooth, which has become very key in computing and many consumer product markets. It is projected to be key for wearable products in particular, again connecting to the IoT albeit probably via a smartphone in many cases. The new Bluetooth Low-Energy (BLE) – or Bluetooth Smart, as it is now branded – is a substantial protocol for IoT applications. *Zigbee:* ZigBee, like Bluetooth, has a large installed base of operation, while feasibly more in industrial settings. ZigBee PRO and ZigBee Remote Control (RF4CE), among other available ZigBee profiles, are based on the IEEE802.15.4 protocol, which is an industry-standard wireless networking technology operating at 2.4GHz pointing applications that necessitate relatively infrequent data exchanges at low data-rates over a limited area and within a 100m range such as in a home or building[3].

Z-Wave: Z-Wave is a low-power RF communications technology that is mainly deliberated for home automation for products such as lamp controllers and sensors among many others. Adjusted for reliable and low-latency communication of small data packets with data rates up to 100kbit/s, it operates in the sub-1GHz band and is impervious to interference from WiFi and other wireless technologies in the 2.4-GHz range such as Bluetooth or ZigBee.

6LowPAN: A key IP (Internet Protocol)-based technology is 6LowPAN[4]. Rather than being an IoT application protocols technology like Bluetooth or ZigBee, 6LowPAN is a network protocol that defines encapsulation and header compression mechanisms.

Thread: A very new IP-based IPv6 networking protocol aimed at the home automation environment is Thread. Based on 6LowPAN, and also like it, it is not an IoT applications protocol like Bluetooth or ZigBee. However, from an application point of view, it is primarily designed as a complement to Wi-Fi as it recognises that while Wi-Fi is good for many consumer devices that it has restrictions for use in a home automation setup[7].

Wi-Fi: Wi-Fi connectivity is often an apparent choice for many developers, specifically given the prevalence of Wi-Fi within the home environment within LANs. It requires little further explanation except to state the obvious that clearly there is a wide existing infrastructure as well as posing fast data transfer and the ability to handle high extents of data.

Cellular: Any IoT application that needs operation over longer distances can take advantage of GSM/3G/4G cellular communication capabilities. While cellular is clearly capable of sending high quantities of data, especially for 4G, the outlay and also power consumption will be too high for many applications, but it can be ideal for sensor-based low-bandwidth-data projects that will send very low amounts of data over the Internet [11].

NFC: NFC (Near Field Communication) is a technology that allows simple and safe two-way exchanges between electronic devices, and especially appropriate for smartphones, permitting consumers to perform contactless payment transactions, access digital content and connect electronic devices[5].

Sigfox: An alternative wide-range technology is Sigfox, which in terms of range comes between WiFi and cellular. It uses the ISM bands, which are free to use without the need to procure licenses, to transfer data over a very narrow spectrum to and from connected objects.

Neul: Similar in model to Sigfox and operating in the sub-1GHz band, Neulleverages very small slices of the TV White Space spectrum to deliver high scalability, high coverage, low power and low-cost wireless networks[6]. Systems are based on the Iceni chip, which communicates using the white space radio to contact the high-quality UHF spectrum, now available due to the analogue to digital TV transition.

LoRaWAN: Again, similar in some respects to Sigfox and Neul, LoRaWAN aims wide-area network (WAN) applications and is designed to provide low-power WANs with features specifically required to support low-cost mobile secure bi-directional communication in IoT, M2M and smart city and industrial applications[10].

III. IMPLEMENTATION MODELS

3.1 Smart Traffic Service

Major smart traffic services include smart parking services to prevent illegal parking and facilitate convenient parking, citizen participation-oriented illegal parking prevention services, and smart safe crosswalk services. Smart parking mentions to the building of a platform that qualifies real-time checking of offered space and parking prices in areas that require parking and expedition of reservation/payment through Web and mobile connections. The citizen participation-oriented illegal parking prevention service is an improvement of the illegal parking crackdown system of the traffic authority by allowing citizens (including victims of illegal parking) to appropriately report such violations through their smartphones. Furthermore, the smart safe crosswalk service can contribute to the deterrence of pedestrian accidents and secondary car accidents by detecting pedestrians in children protection zones, and alerting pedestrians and upcoming vehicles from side to side electronic display boards[3].

3.2 Smart Education Service

This service offers instantaneous, cooperating high-definition lectures that feel like face-to-face meetings at home over high-definition (HD) services and wide-area Internet infrastructure. Instructors contribute in the lectures by using equipment in private educational institutes or separate places, and even foreign language teachers in other countries can contact this service over the Internet.

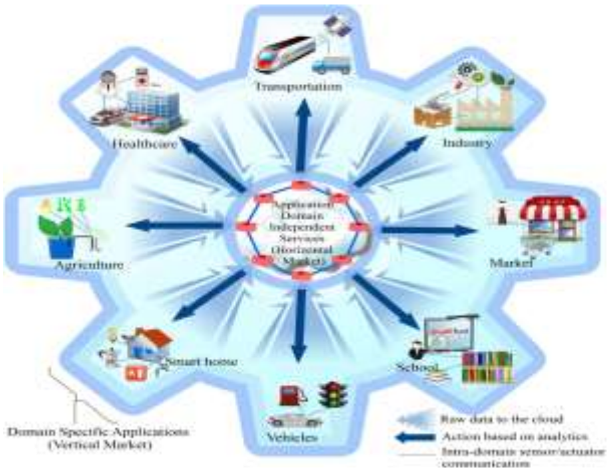

Fig-2: Smart Education Service

3.3 IoT meets Robotics

An developing class of mini-robots will receive from the same confines as contemporary IoT devices (e.g. actuators) comprising very incomplete memory, finite handling power, and strong energy boundaries. In the next, we pay responsiveness on three significant features in IoT robotics: hardware aspects, software aspects, and network aspects[2].

Hardware Aspects: From a hardware view, a robot consists in (i) structural and mechanical components, e.g. carcass, frame, wheels, (ii) sensor and actuators, e.g. motors, distance sensors, (iii) computational elements and electronics, e.g. micro-controllers, motor controllers, and (iv) power supply, e.g. batteries. Newly, the rise of open source hardware and the maker scene lead to increased availability and such a noteworthy price drop for these components that mini-robots under $10 are becoming a reality. General illustrations of structural components include Lego, while 3D printers allow almost someone to conveniently make ritual parts with a high precision.

Software Perspective: The software running on IoT mini-robots consists in (i) hardware abstraction and device drivers, (ii) control software, (iii) communication software, and (iv) a systems layer that glues together all these elements. The most popular software base for robots is the Robot Operating System (ROS) a set of libraries and tools running on top of a host operating system.

Network Challenges: On the network side, IoT mini robots need (i) enriched algorithms and protocols, and (ii)novel/holistic network architectures. Above-mentioned controls on software and hardware translate into challenges for network technologies, which are expected to operate with low memory foot-print, low energy depletion, and high consistency over wireless, and to interoperate with the Internet.

3.4 Smart Hospitals

In this application, the sensor will attain the data from the instantaneous that is temperature sensor will regularly show the temperature of the patient's room, ultrasonic sensor will display the level of saline bottle and LDR(Light Dependent Resistor) will display the illumination of a light on it in terms of resistance value. Data acquire by all of the sensors will be interconnected by USB(Universal Serial Bus) which is used for the data transfer to the Arduino mega board. This data is then accessible to the MQTT broker server via ethernet cable. When one wants to obtain this data then that person has to subscribe to the MQTT server and then hospital staff he/she can monitor the data received. MQTT platform is used to control to the switch which will ultimately control electrical appliances. Whenever temperature of the patient's room increases above predefined level, it will send the data to the page and then from the webpage or from the mobile device. In case of saline bottle, level of the saline bottle unremittingly send on to the server so that hospital staff need not to go to each and every patient's room to monitor it. As soon as the level of liquid in a saline bottle falls below predefined value then nurse can go to the patient's room and change that bottle.

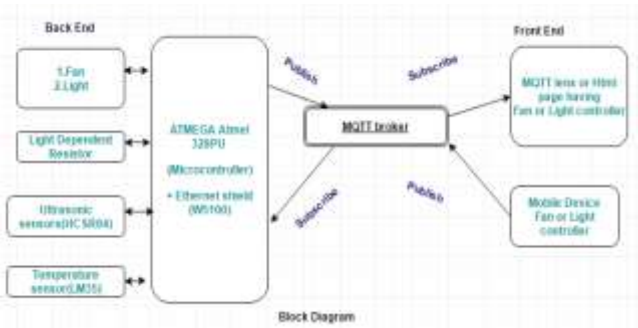

Fig-3: Smart Hospitals using IoT

3.5 Water Reservoir Monitoring

Monitoring the quality of the water resources is essential need to avoid critical effect on human life filed, which causes dieses through contaminated water. Water gets polluted in many ways like industrial wastages, due to disaster, or human being. So that people need to get awareness locality water condition. Dynamic power management with scheduled switching mode used to switch a sensor node to sleep mode after transmitting a data packet.

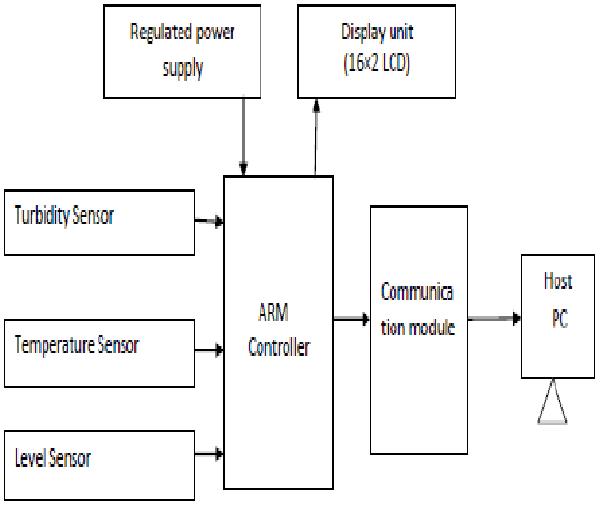

Fig-4: Water Reservoir Monitoring using IoT

Presently monitoring the polluted water resources is vital need to avoid major effect on human life, filed, industrial application, to mitigate and monitor critical situation from contaminated water. A design which includes interface device to collect data effectively from diverse sensor and MCU for controlling the entire operation and for some pre-processing[1]. The presentation analysis has been displayed and an passable effect is carried out on water reservoir monitoring for industrial application by detecting the value from temperature sensor, level sensor turbidity sensor.

3.6 Smart Campus

The application structure of estates is a blend of IOT and distributed computing taking into account the elite processing and the web. The frameworks as a associate stage, grounds can sort educators, understudies, folks, ventures and specialists ready to oversee, impart and concentrate on. The use of grounds is made out of presenting administration, library administration, participation administration, and so on grounds understands the card administration comprising involvement get to control card, library card and so forth.

Teaching management: In the grounds, we doesn't require to establish a man Specialist to bear on the scrutiny participation insights, analysis reports and the administration. Understudies can check in utilizing card and versatile/web program that have the RFID name/QR code/ID, the data of the understudies are additional to the database, the staff, understudy and folks can ace the on-going data and execution of replacements from the our database framework.

Library management: We can have the new direction illustration in the library by consolidating conventional and advanced by IOT. The library takes the points of interest nourish into electronic RFID tag. These labels combine the cellular telephone, library card and other physical questions. Client can get the required administration and assets at anyplace through Internet innovation. The new model can understand the communication in the middle of client and library, client and asset.

Attendance-monitoring management: A participation observing framework serves to give us a period log that is set up as a efficient database utilizing cloud innovation. A contribution read-through framework keeps up an every day, week by week, month to month record of a man's entry and take-off time from work or grounds.

Forum: Gatherings spare data posted on a specific theme by the general population to see at whatever time, anyplace, this makes an examination domain between clients. All that gets forwarded by the client's gets read over and over. Discussions permit to make strong online groups amongst clients even with low movement volumes.

3.7 IoT in Agriculture

Two soil moisture sensors along with LM35 comparator modules were positioned in different soil circumstances for analysis. The sensor is made up of two electrodes. It recites the moisture content around it. A current is passed across the electrodes over the soil and the resistance to the present in the soil controls the soil moisture. If the soil has more water resistance will be low and thus more current will pass through. On the other hand when the soil moisture is low the sensor module outputs a high level of resistance[7]. This sensor has both digital and analogue outputs. Digital output is simple to use but is not as accurate as the analogue output. Temporarily the Arduino 328P-PU microcontroller used for the Arduino Uno contains an onboard 10-bit 6-channel analog-to-digital (A/D) converter, the analog input pin of Arduino can read analog signals being sent from the sensor and return binary integers from 0 to 1023. Soil moisture, Sensor, Humidit, Sensor, Buzzer, Gsm modem, Sim800l, Temperature, Sensor, Lcd, Power supply, Arduino uno r3

Dc motor pump, Water level, Sensor Information from the sensors is conveyed to the arduino board. The arduino board consists of microcontroller ARDUINO328P which is answerable for observing the switching on/off of the motor on which water sprinklers can be fixed. Sensor values from arduino are conveyed to the GSM-GPRS SIM900A modem. A Sim with 3G data pack is inserted into this modem which provides IOT features to the system. Values are more diffused IOT section through the modem. The GSM modem is a highly stretchy plug and play quad bandSIM900A GSM modem for direct and easy integration to RS232 applications. It maintenance features like SMS, Data/Fax, GPRS tx and rx pins from arduino are linked to the rx and tx of GSM modem correspondingly. Farmer gets the emails alerts when the sensor's threshold values exceeds and even when there is no water in the field he gets warns to on the motor, if there is maximum water available he gets the alert to off the motor. Then the code that connects with the server sends the data from the server database cloud to the email names which are given in the code that is uploaded in the server.

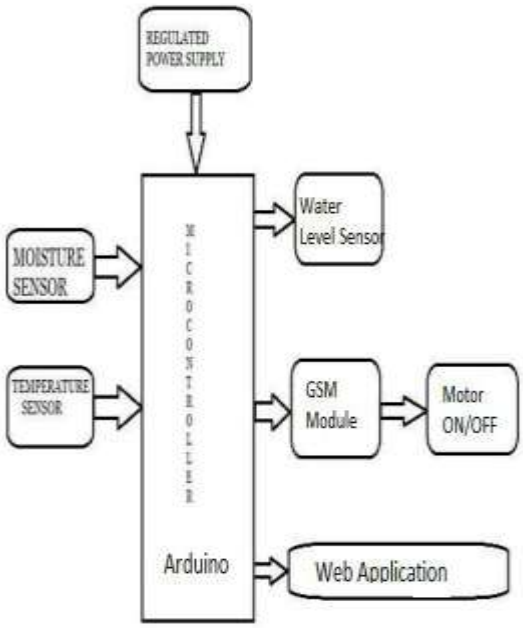

Fig-5: IoT in Agriculture

I V. COMPARISON ON IMPLEMENTATION MODELS

Table-1: Comparison on Implementation Models

IoT Smart Applications							
Aspects	Smart Traffic Service	Smart Education Service	IoT meets Robotics	Smart Hospitals	Water Reservoir Monitoring	IoT in Agriculture	Smart Campus
Technical Environment	Usage of SmartPhones, Processing Power	High Definition Services, WideArea Internet, Infrastructure	IoT Devices-Actuators, Processing Power	Serverbased Web Access, MicroController	ARM Controller	Arduino Uno A/D Converter	IoT, Cloud, RFID
Application Oriented	Web based	Sensor Ability	Actuators, Sensors, Computational Elements	Sensor Ability, Ultrasonic sensors	Turbidity Sensor, Temperature sensor, Level Sensor	Sensor Ability	Sensor Ability
Management System	Web and Mobile Connections	Internet	Enhanced algorithms, Protocols	Web based, Internet	Regulated Power supply, Communication Module	Low Power Supply	System Sharing, Intelligent
Real Time Notification	Electronic display boards	High reliability, Interoperability	High Reliability, Novel Network architectures, low energy consumption, Interoperability	Mobile devices, display devices	Display units	Analog Outputs, Level of resistance	Sensing the content of user

IV. CONCLUSION & FUTURE SCOPE

In this paper, the comparison between various implementation models that use IoT technology has been presented according to various aspects they are supported to and technologies implemented in developing those applications. It is clearly shown in the table-1 regarding these comparisons which shows the technology improvement and utilization of the resources from various perspectives. This helps all kinds of users to have a quick access and get familiar with the technology and make them lead the IoT technology in an enhanced way.

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