

IoT Edge Gateway Solution

PROJECT REPORT

Deep Ashokkumar Parmar | 140130107055
Sneha Jitendrabhai Bhattasana | 140130107008
Prof. M.B. Chaudhary | **Faculty Guide**
Gujarat Technology University | 7th semester 2017

Acknowledgement

We would like to thank our college for giving us an opportunity to commence this project in first intense to so the necessary work. We also thank all the faculties for their nice cooperation to the all B.E. student of Computer Engineering Department. We specially thank to our Internal guide **Prof. M.B. Chaudhary** for helping us and guide us on our project. We are especially thanks to our friends and classmate of **Government Engineering College, Gandhinagar** for their help in our project work.

Thanking you,
Deep Parmar
Sneha Bhattasana

Abstract

IoT Edge Gateway Solution is a platform consisting web application and/or mobile application. In which you can build prototypes or create complete IoT projects with drag and drop IoT project builder. Not only you can build projects, you can maintain and monitor it also. We are going to use cloud technology for services. In this project builder, you can use very popular development boards Arduinos and Raspberry Pi. Each and every standard sensor and actuator are also included to build, maintain and monitoring your project. With this platform, you can really manage real time data triggering. Platform also provide real time notification. By using this platform, you can build your project in just few minutes. In short, this platform provides less coding, no redundancy and fastest and most efficient way to build an IoT project or prototype.



Certificate

This is to certify that the **Mr. Deep Parmar** of Computer Engineering **4th year, 7th Semester** Enrollment number: **140130107055** has satisfactorily completed his term work in project (2170002) under the title “**IoT Edge Gateway Solution**” for the term ending Oct-Nov 2017.

Faculty Guide

PROF. M.B. CHAUDHARY

Head of Dept.

(C.E.)



Certificate

This is to certify that the **Ms. Sneha Bhattasana** of Computer Engineering **4th year, 7th Semester** Enrollment number: **140130107008** has satisfactorily completed his term work in project (2170002) under the title “**IoT Edge Gateway Solution**” for the term ending Oct-Nov 2017.

Faculty Guide

PROF. M.B. CHAUDHARY

Head of Dept.

(C.E.)

Index

| | |
|--|----|
| CHAPTER 1: INTRODUCTION | 6 |
| 1.1 Problem summary | 7 |
| 1.2 Project detail | 7 |
| 1.3 Aim & Objectives | 8 |
| 1.4 literature review and Prior Art Search | 8 |
| 1.5 Plan of Work | 10 |
| 1.6 Material/Tools required | 11 |
| CHAPTER 2: DESIGN | 12 |
| 2.1 Design methodology | 13 |
| 2.2 Implementation Strategy | 20 |
| CHAPTER 3: IMPLEMENTATION | 21 |
| 3.1 Screenshots | 22 |
| CHAPTER 4: SUMMARY | 24 |
| 4.1 Advantages | 25 |
| 4.2 Scope of future work | 25 |
| 4.3 Problem solved | 25 |
| 4.4 Features | 26 |
| 4.5 Limitations | 26 |
| 4.6 Conclusion | 26 |
| CHAPTER 5: REFERENCE | 27 |
| 5.1 Referred Web-Sites | 28 |
| SCHAPTER 6: APPENDIX | 29 |
| 6.1 PPR | 30 |
| 6.2 PSAR | 38 |
| 6.3 Design Engineering Canvases | 53 |

Chapter 1: Introduction

1.1 Problem Summary

IoT is emerging field in these days. IoT consists of two great subjects for application. One is internet, which contains protocols for communication, lots of data to manage, and much more. Other one is thing part, in which devices which are made of circuits, sensors and actuators. While building an IoT project we often have to deal with programming same things again and again, that leads to redundancy and it is very time consuming too. Often, we need some interface through which user can give inputs or get informed. IoT consists of real time data and actions related to some constraints on that data. It is very hard to maintaining IoT devices. Usually, IoTs contains of real time data and actions related to that data and some constraints on that data. Managing that real-time data user will definitely need some framework or support and monitoring system. These all reasons lead to very time consuming and tedious process to make any working prototype or complete IoT project.

1.2 Project Details

IoT Edge Gateway Solution is the project title. As title suggest It consists a solution in a way of web application and Mobile application. In which user have to register in order to maintain their states of activities. This platform support very famous development boards and environments like ARDUINO and RPI. This platform also supports all standard actuators and sensors. After registering users have to setup their circuit physically. After setup, they can add their sensors and actuators in with providing few correct details. Auto code generator will generate code based on given information. Copy and paste the generated code to the IDE and upload it to your board. Now your board is connected to the platform. Now you can add as many sensors as you want and also actuators. You can schedule tasks. You can also monitor all the real-time data. You can do triggering. This is the Basic details about the project. Whole platform is built on the reliable cloud services. This project is going to build using the latest reliable technologies available in the market. In few Words, we can say that it is drag and drop IoT project builder with some special features to save time and efforts.

1.3 Aim & Objectives

Our aim behind this project is to create a platform which provide drag and drop IoT project builder with monitoring and maintenance facility. Objectives are as following.

1. In IoT projects we often have to code for the same thing with minor difference frequently. Our one objective is to remove that redundancy.
2. Monitoring real time data and also statistics for CPU and RAM for development board.
3. Using monitoring on the devices we can take care for maintenance by providing options for it.
4. When certain constraints are satisfied on real time data triggering can be done with some actions on actuators.
5. Scheduling for some actions can be provided by this platform.
6. For reducing redundancy, we provide some intelligence to auto generate most code for program the device and manage it.
7. Auto generated code is tends to be errorless.
8. Creating IoT projects in just few minutes.

1.4 Literature Review & Prior Art Search

- For project definition we reviewed many web sites which are as follows.
 - <http://www.ieeefinalyearprojects.org/domain.html>
 - <https://www.quora.com/What-is-the-best-domain-to-do-your-final-year-project-in-CSE>
 - <http://cse.final-year-projects.in/>
 - <http://ieeeproject.org/ieee-projects-cse/cse-final-year-projects/>
 - <http://ieee-projects-chennai.com/ieee-projects-domains.html>
 - <http://www.happiestminds.com/solutions/midas-service-platform/>
 - https://en.wikipedia.org/wiki/Internet_of_things
 - http://www.happiestminds.com/brochures/M2M_Brochure_o.pdf
 - <https://www.analyticsvidhya.com/blog/2016/08/10-youtube-videos-explaining-the-real-world-applications-of-internet-of-things-iot/>
 - <https://www.ibm.com/blogs/internet-of-things/iot-applications-industries/>
 - http://www.cisco.com/c/en_in/solutions/internet-of-things/overview.html?stickynav=1
 - <http://www.mydevices.com>

- We referred following web sites during our learning process.
 - <https://www.coursera.org/specializations/iot>
 - [http://www.happiestminds.com/brochures/M2M Brochure o.pdf](http://www.happiestminds.com/brochures/M2M_Brochure_o.pdf)
 - <https://www.arduino.cc/>
 - <https://www.raspberrypi.org/products/raspberry-pi-3-model-b/>
 - <https://www.heroku.com/free>
 - <https://firebase.google.com/pricing/>
 - <https://www.sitepoint.com/sitepoint-smackdown-php-vs-node-js/>
 - <https://medium.com/unexpected-token/10-weeks-of-node-js-after-10-years-of-php-a352042c0c11>
 - <https://www.pluralsight.com/>
 - <https://www.lynda.com/>
 - <https://developer.android.com/index.html>
 - <https://www.udacity.com/>

We did many research on patterns. In one pattern we learned that how to use gateway to solve some problems related to IoTs. That's given as follows.

gateway is configured to perform a method that includes receiving data from a first device using a first protocol. The first protocol is a cloud based protocol. The method also includes determining that the received data is intended for a second device that uses a second protocol. The method further includes converting the received data from the first protocol to the second protocol. In addition, the method includes transmitting the received data to the second device via the second protocol.

In another pattern we learned about perfect architecture for IoTs. Which is as follows.

At first, we have to register IoT Gateway and deploy it. We have to connect it to the management server. Then install edge agent on gateway. Install multiple apps and sensors and actuators. If we want to change settings for application or driver, we can do it via Edge Agent. If there are trigger or threshold events, we also can manage through IoT gateway.

1.5 Plan of Work

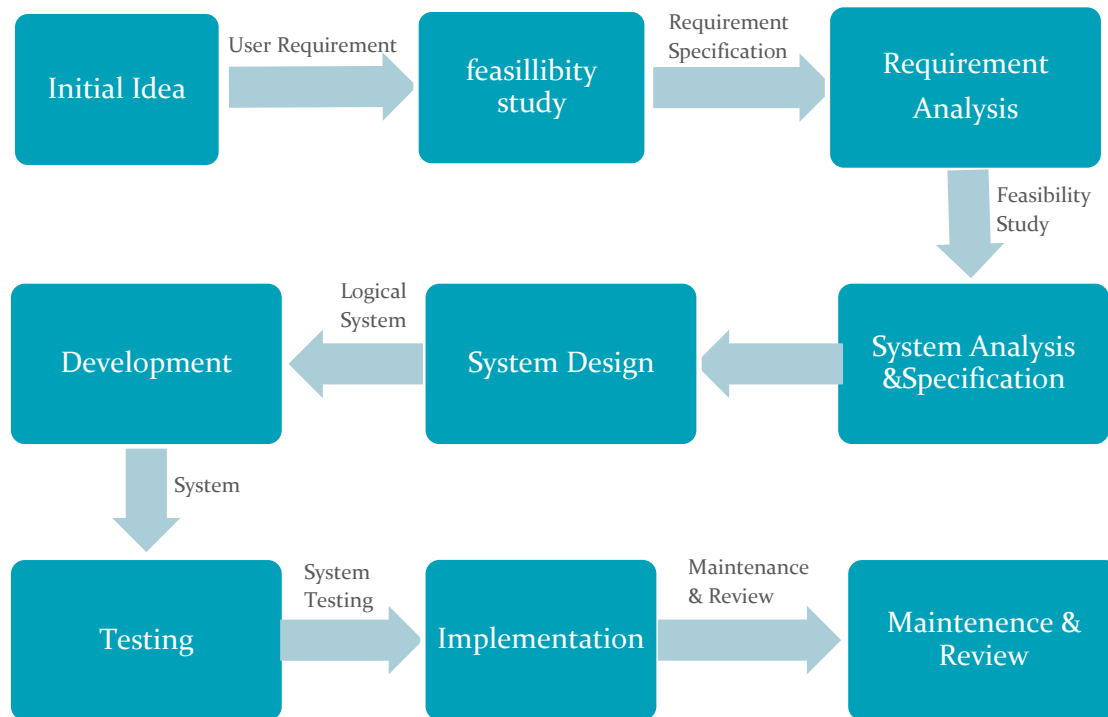


Fig. 1.5 Plan of work

Plan of Work with days calculation: -

| SR. NO. | TASK | DAYS |
|---------|-----------------------|------|
| 1. | Requirement Gathering | 20 |
| 2. | Analysis | 20 |
| 3. | Planning | 20 |
| 4. | Designing | 35 |
| 5. | Development | 70 |
| 6. | Testing | 20 |
| 7. | Deployment | 20 |

1.6 Materials & Tools Required

1. Arduino and Raspberry Pi **Development Boards** are required.
2. Different **sensors and actuators** are required for testing purpose.
3. **Connecting wires** are required.
4. Python package installer for **python 2.7** required.
5. Python package installer for **Django framework** required.
6. **Bootstrap v4** required.
7. Arduino IDE and Python IDE required.
8. **Editor** (i.e. Atom) required.
9. **Angular.js** framework installer required.
10. **Linux/Windows** Systems required.
11. **NOOBS** for Pi required.
12. **Internet and ethernet** cable required.

Chapter 2: Design

2.1 Design Methodology

2.1.1 Planning

We are going to follow waterfall model to design and build this project. Figure given below is just abstract steps for design this product. Detailed steps are given in **topic 1.5** (plan of work). First, we will work on initial idea and later these all requirement, analysis and design phases. Then we head to implementation strategies and maintenance.

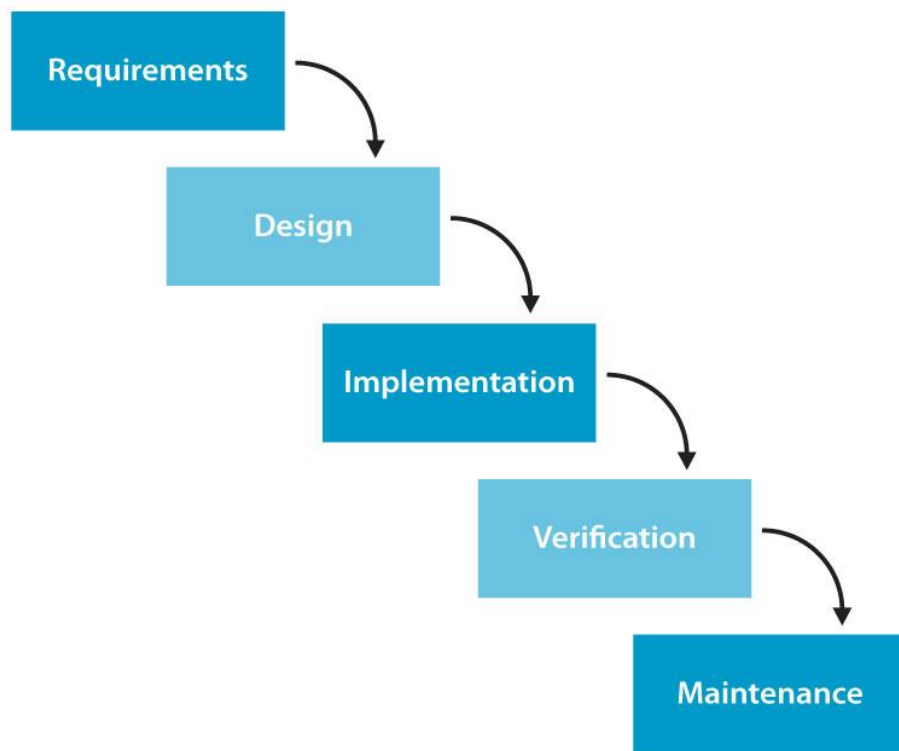


Fig. 2.1 waterfall model

2.1.2 Initial Idea

After empathy mapping, we found some key problems which can be solved by us as an effective and efficient solutions. Problems are related to cutting edge, fastest growing technology **Internet of Things**. The problems are like they have redundant tasks which make the development process boring and time consuming. Lack of framework/Tool which can provide some automation and intelligence. They also need some functionality to monitoring and notify to maintenance. During the ideation canvas we came to know that we can solve their most problems by providing a platform which can do monitoring, notify, auto code generation, and speed up the process. So, we came up with a solution to make a unique platform as a web application and mobile application.

2.1.3 Feasibility Study

Feasibility study is an assessment of the practicality of a proposed project or system. In this project we are willing to provide service and product also. Here we provide application platform as a service(aPaaS). In this service we can provide IoT drag & drop project builder for selected development boards. We also provide monitoring and maintenance on IoTs. We also provide products on request for special/particular hardware.

Now let's talk about TELOS. The acronym TELOS refers to the five areas of feasibility - Technical, Economic, Legal, Operational and Scheduling.

1. **Technical Feasibility:** In this project we are going to build a web application and an android application to provide services. If we use latest technologies like for building the application then this project should be feasible. By using cheap cloud solutions and deploying, hosting solutions, we can increase feasibility. In short, the project is technical feasible.
2. **Economic Feasibility:** This project consists of web app and mobile app. There are many cheap hosting and cloud solutions available in market so it would be feasible in aspects of economics. For testing purpose, we can test on hardware if it is available at low cost. Or we can use simulators. Overall this project is economical feasible.
3. **Legal Feasibility:** We provide services to build IoT projects. They are pretty much legal. There is no such patent registered like this project. There is not a single violation of any rule. So, this project is legally feasible.
4. **Operational Feasibility:** Solutions provided for given problems are quite effective and efficient in all manners. Platform provide drag and drop project builder with auto code generation and also with monitoring and maintenance. We can say that the project is operational feasible.

Here at first in analysis part the identification of stack-holders is required. In this case stack holders can be a student learning IoT or an IoT developer or possibly IoT industry person. Identified problems are redundant tasks which make the development process boring and time consuming. Lack of framework/Tool which can provide some automation and intelligence. They also need some functionality to monitoring and notify to maintenance. In order to provide solution, we can use the use case diagram in which there are functions like create project, maintain, monitor and schedule some task and so on. We can define relations between the entities as follows.

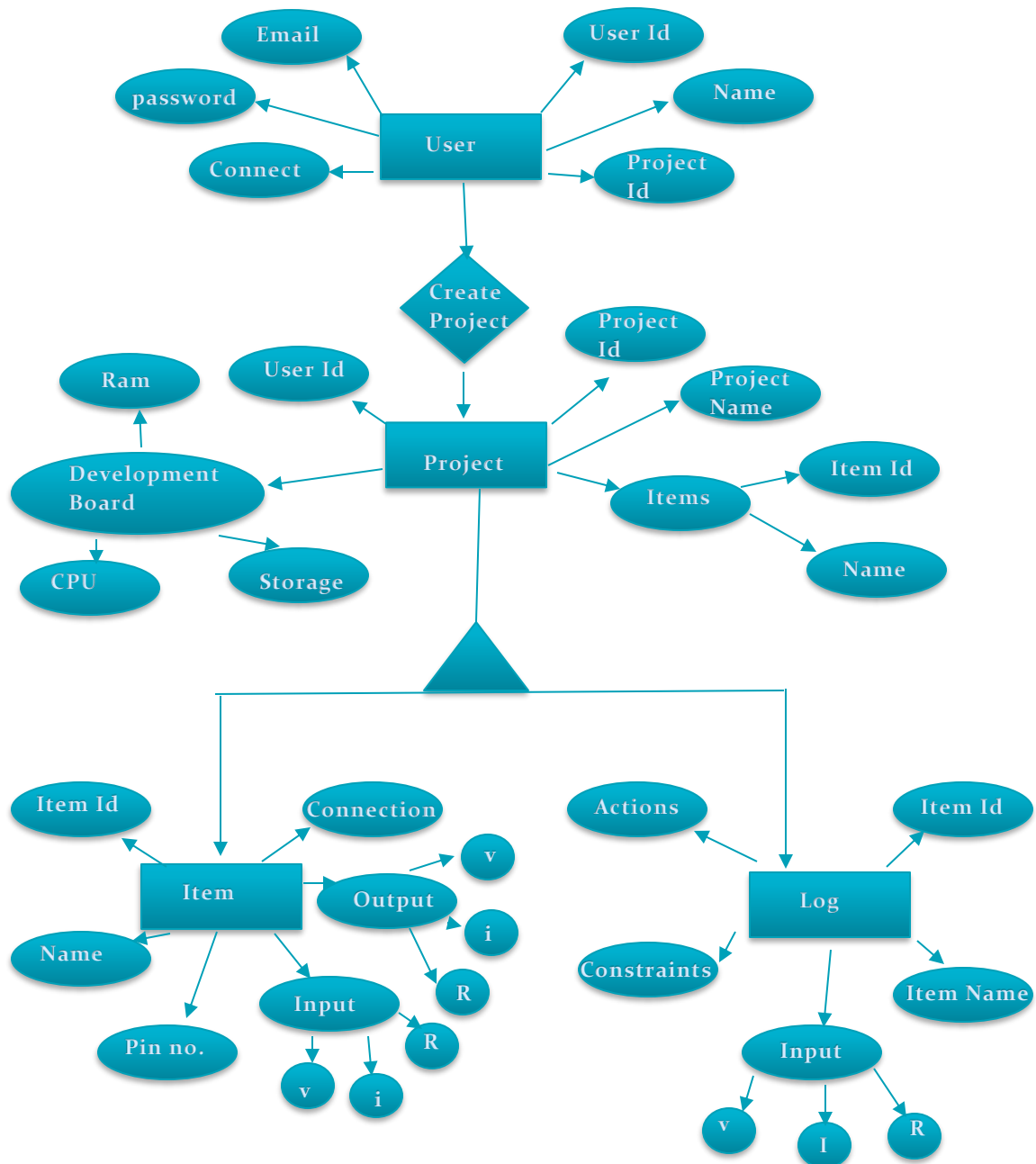


Fig 2.3 E-R Diagram

2.1.5 Design

With following diagrams, we can design the project and overall system can be understood.

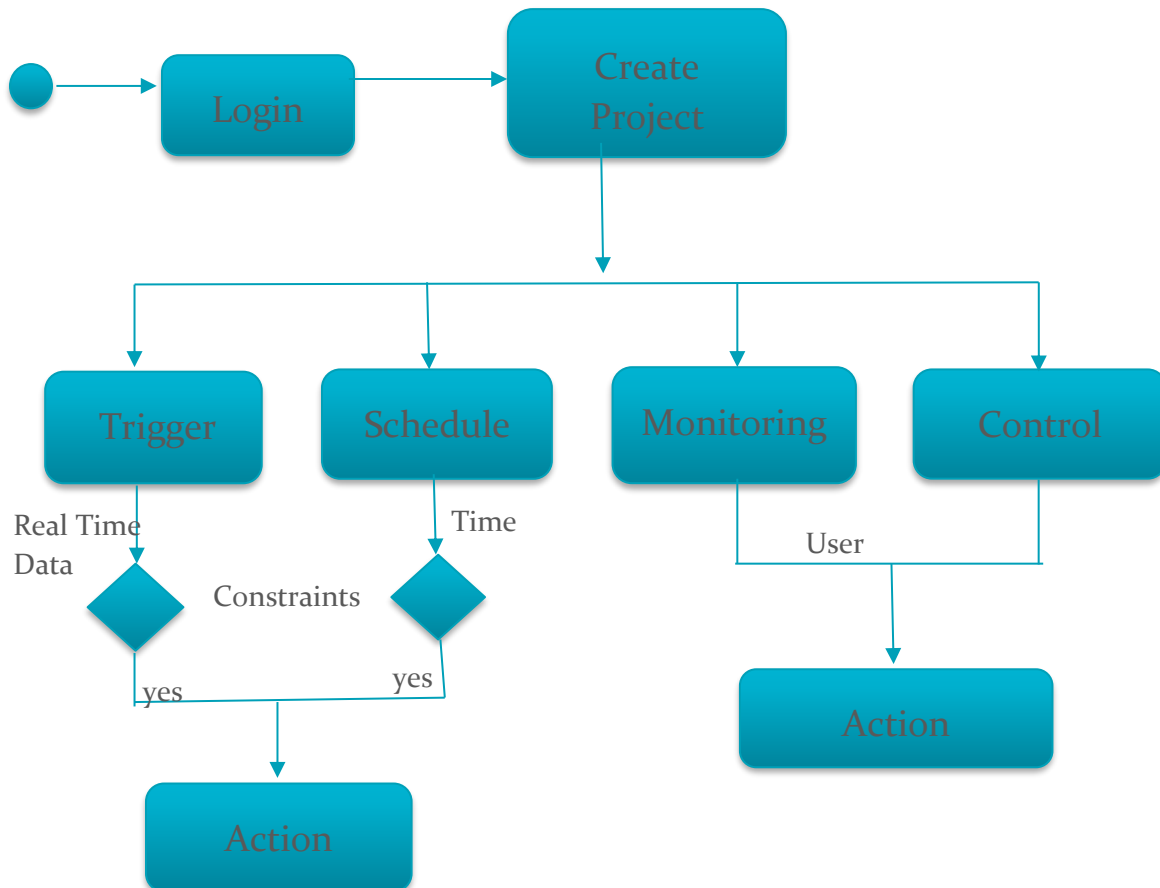


Fig 2.4 Activity Diagram

Figure above is showing activity can be done by user on abstract level. User can create project and by using different options it can manage it control it and schedule it. Creation process is made simple with auto code generation and some intelligence. Constraint based actions are done in triggering and scheduling. User can also manually do actions. These are the basic activities can be done by any user.

With Class diagram we can be much precise about the functions and other design related parameters. The Class diagram is as given below for this system.

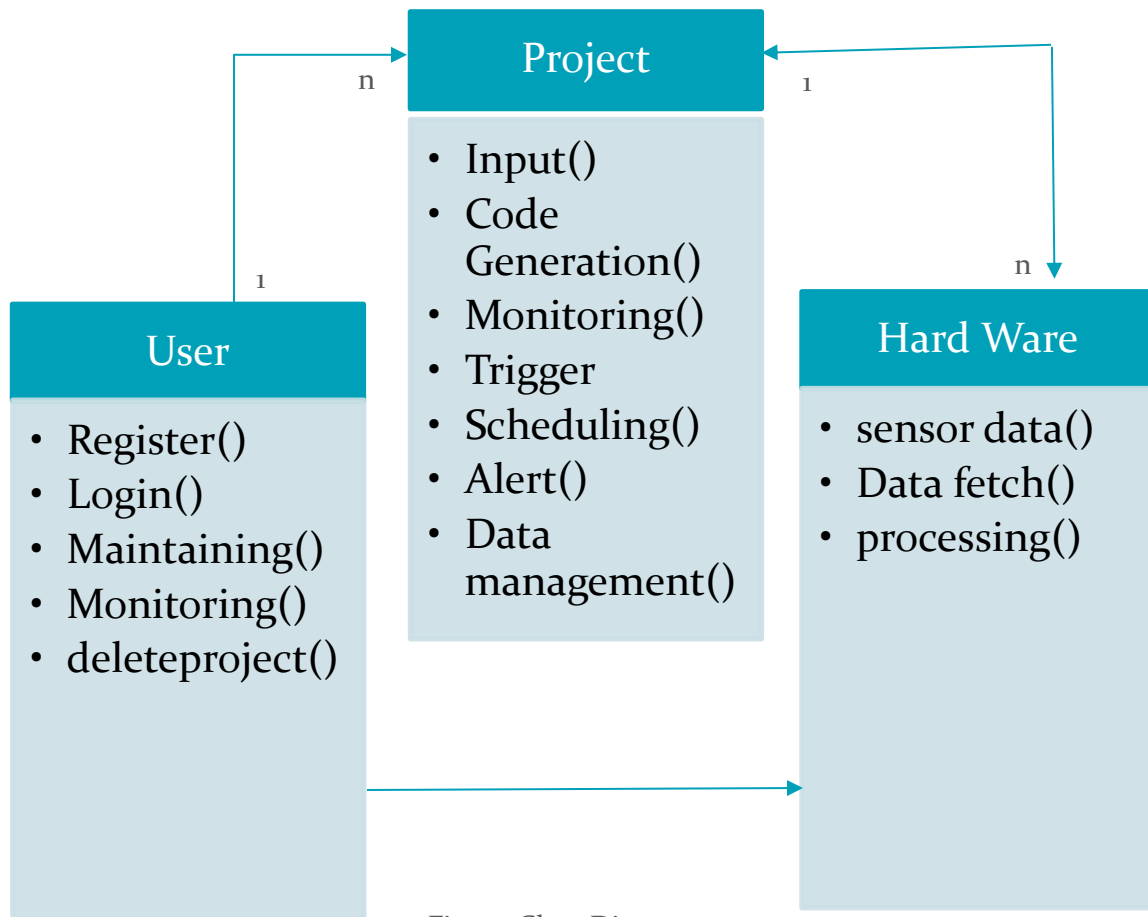


Fig 2.5 Class Diagram

As shown in figure, we can see that a user can do the process of registration in order to use the service. Then they have to login with given username and password. User can also see many important real-time data. And he can also delete the project and create. Creating project includes taking inputs from the users. Then system will generate code with help of the code intelligence according to the given inputs. System will update the different parameters in order to monitoring and maintenance. Using system user can schedule some action on time. User can also trigger some event when some condition is satisfied. System will also manage the real-time data. On other hand the hardware/Thing is also connected to the system it will send and receive some information and data. Process can be done according to the instructions.

All actions and task are very well defined. Now the sequence is important. In which order all the tasks or actions can be done. We can define it very well with the sequence diagram which is as follows.

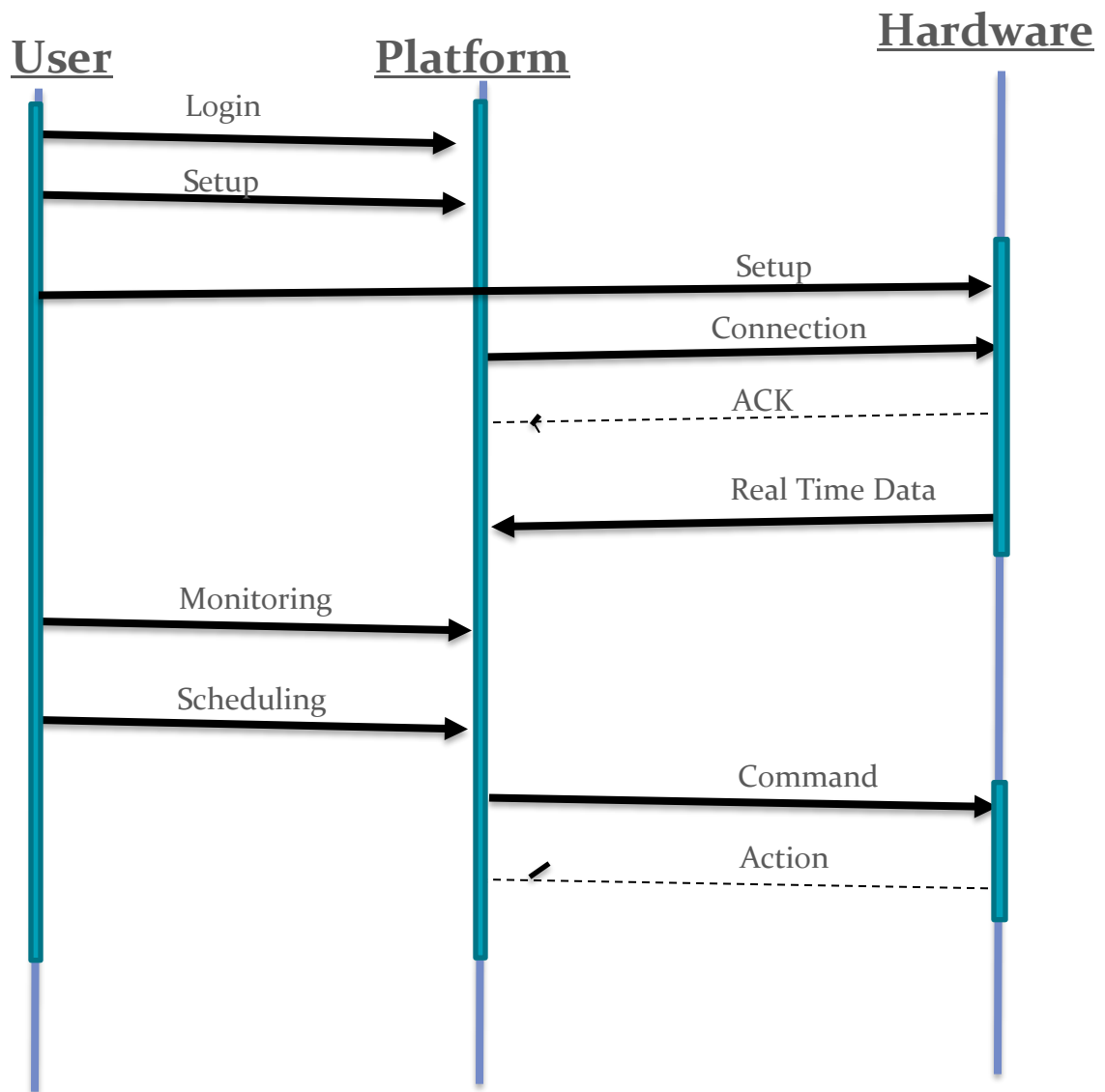


Fig 2.5 Sequence Diagram

All actions are shown in sequence in the sequence diagram.

2.2 Implementation Strategy

We are going to use modular approach to implement this project. First, we divide whole system into small but loosely coupled parts. So that coding part will be easy for us. Individual modules are as follows.

- User Registration
- User Authentication
- Project Creation
 - Development Board SETUP
 - Connection
 - Sensor Setup
 - Sensor Connection
 - Actuator Setup
 - Actuator Connection
- Project Maintenance
- Triggering
- Scheduling
- Monitoring
- Alert

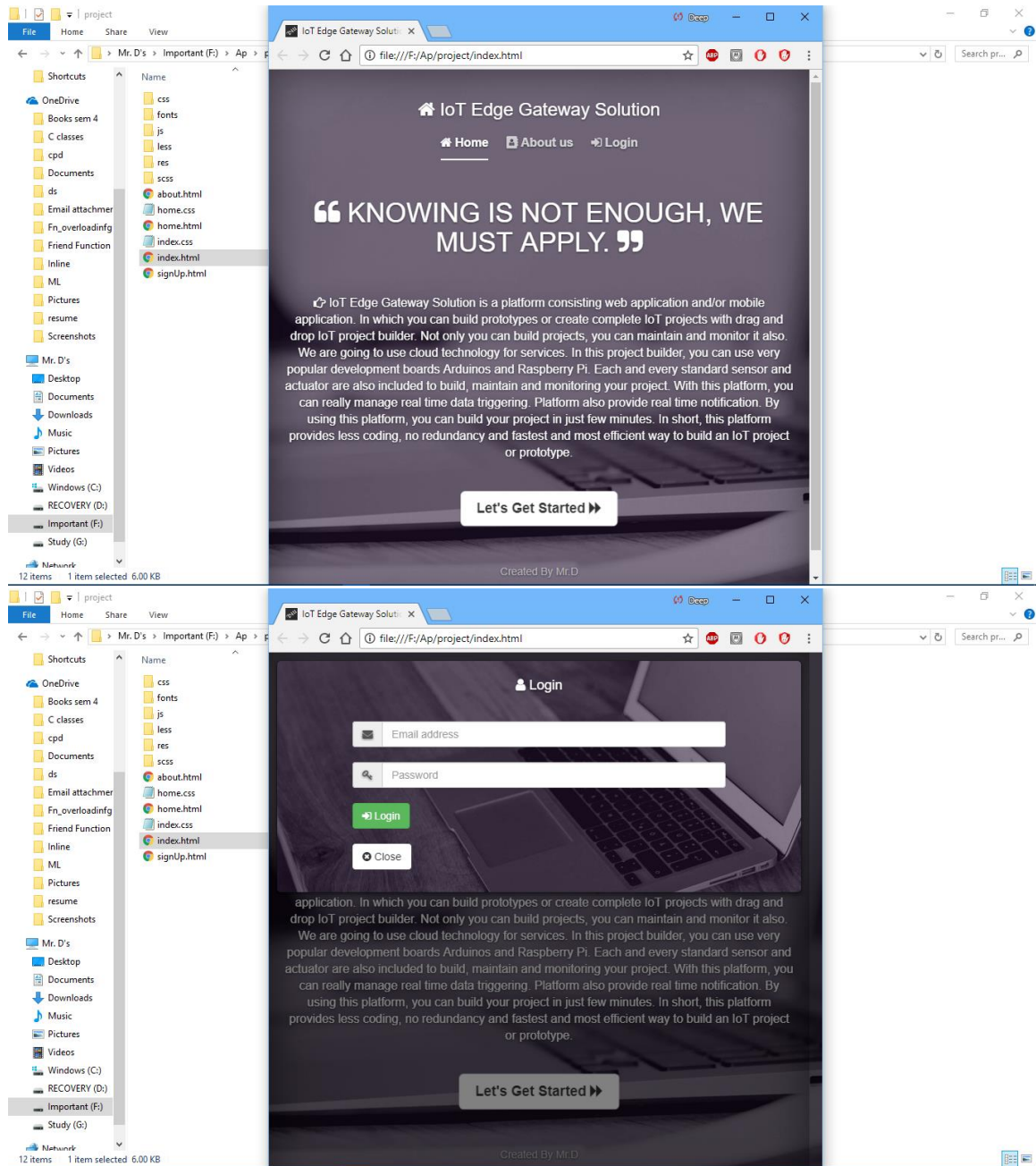
Now let's talk about Technology stack. First let's have look at web application. Front end will be made by HTML5, CSS3, Bootstrap V4, Angular JavaScript. Backend will be either made by Node.js or Django python framework. For real time database and cloud services we will use Firebase. For load balancing and other necessary handling task we are going to use amazon web services. For mobile application we are going to use android development.

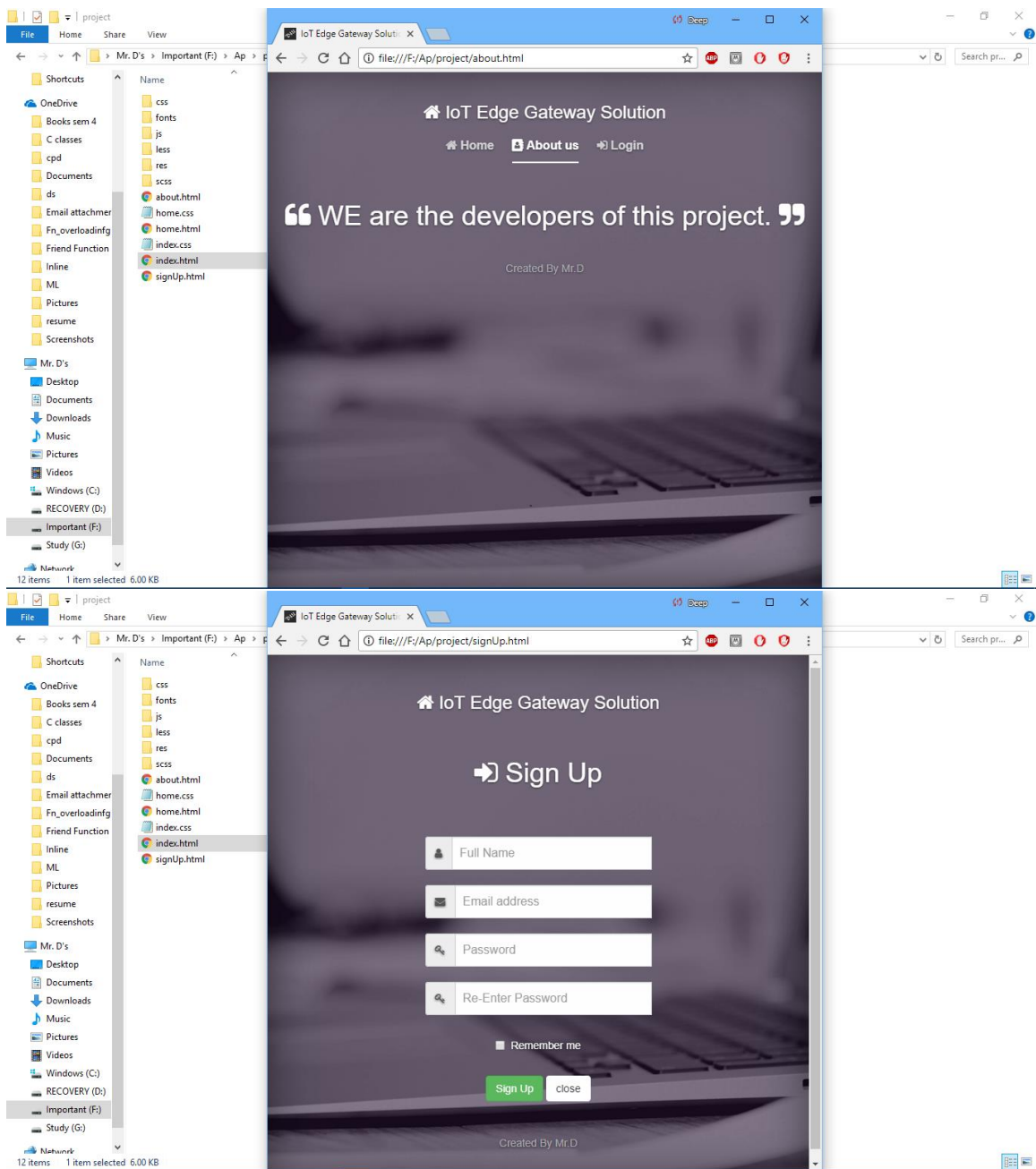


Above figures shows the technologies and how we are going to use it.

Chapter 3: Implementation

Screenshots





Chapter 4: Summary

4.1 Advantages

There are many advantages which are as follows

1. Auto code generation and drag n drop project builder speed up IoT project building extremely fast.
2. Generated codes are tending to be error less. So, zero error guaranteed.
3. Inbuilt intelligence provided by platform not to worry about little things.
4. Due to inbuilt intelligence and using of cloud services platform provide efficient real-time data management.
5. IoT project builder is more like drag n drop which makes it very easy to use.
6. Platform provide security with customized secure protocols for connections.
7. Monitoring and maintenance are also available.
8. Customized dash board and many features can be customized like Scheduling and triggering.

4.2 Scope of Future Work

We are going to add more usable sensors and actuators to our projects. We will try to make it better and better day by day. We will also add more popular development boards in future. We are going to make this project as product also by providing the solution to particular problem via our platform.

4.3 Problem Solved

Following problems are solved by this project.

1. Time Consuming Process: Drag n drop project builder with auto code generator solved this problem and make this process very hard.
2. Errors: Auto code generator with inbuilt intelligence provide absolute zero error.
3. Lack of platform: Platform which also provide all the solution to the given problem with also real-time data management, Monitoring and Maintenance facilities.

4.4 Features

1. Customizable Dashboard: Customized dashboard can give you full control over your connected devices. Monitor it, control it, maintain it through the dash board.
2. Remote Monitoring: Platform is built as a web application & mobile application. Only browser is needed to do all the work.
3. Alerts: Constraint based alerts can be set.
4. Schedule: Can schedule a task to do something with the thing.
5. Triggers: Constraint based actions are done.
6. Real time data: Real time data access and monitoring.
7. Custom code: Customize code to do more.

4.5 Limitations

In this project we only support Arduino and Raspberry pi development boards. We provide a platform which only deals with the soft “Internet” part. User still have to do the circuit / physical things building work to himself.

4.6 Conclusion

As we can see, we can use this project as a platform to build prototypes or whole IoT projects by just drag and drop or providing little information. Platform provides best features and functionalities which can solve all the problems. Using this platform user can create IoT projects in few minutes. Not just create them they can constantly monitor it and maintain and remotely control them. It is the revolutionary project which save both time and effort.

Chapter 5: Reference

Websites referred:

- https://en.wikipedia.org/wiki/Internet_of_things
- <https://www.analyticsvidhya.com/blog/2016/08/10-youtube-videos-explaining-the-real-world-applications-of-internet-of-things-iot/>
- <https://www.arduino.cc/>
- https://www.cisco.com/c/en_in/solutions/internet-of-things/overview.html?stickynav=1
- <https://www.coursera.org/specializations/iot>
- <https://www.cse.final-year-projects.in/>
- <https://www.developer.android.com/index.html>
- <https://www.firebase.google.com/pricing/>
- https://www.happiestminds.com/brochures/M2M_Brochure_o.pdf
- https://www.happiestminds.com/brochures/M2M_Brochure_o.pdf
- <https://www.happiestminds.com/solutions/midas-service-platform/>
- <https://www.heroku.com/free>
- <https://www.ibm.com/blogs/internet-of-things/iot-applications-industries/>
- <https://www.ieeefinalyearprojects.org/domain.html>
- <https://www.ieeeproject.org/ieee-projects-cse/cse-final-year-projects/>
- <https://www.ieee-projects-chennai.com/ieee-projects-domains.html>
- <https://www.lynda.com/>
- <https://www.medium.com/unexpected-token/10-weeks-of-node-js-after-10-years-of-php-a352042c0c11>
- <https://www.mydevices.com>
- <https://www.pluralsight.com/>
- <https://www.quora.com/What-is-the-best-domain-to-do-your-final-year-project-in-CSE>
- <https://www.raspberrypi.org/products/raspberry-pi-3-model-b/>
- <https://www.sitepoint.com/sitepoint-smackdown-php-vs-node-js/>
- <https://www.udacity.com/>

Chapter 6: Appendix

6.1 PPR

6.1.1 PPR₁

College : GOVERNMENT ENGINEERING COLLEGE, SECTOR - 28, GANDHINAGAR
StudentName : Parmar Deep Ashokkumar
EnrollmentNo : 140130107055 Department : Computer Engineering
MobileNo : 9428013486 Discipline : BE
Email : deep56parmar@hotmail.com Semester : Semester 7

PPR Details

Periodic Progress Report : First PPR

Project : IoT edge gateway solution

Status : Reviewed

1. What Progress you have made in the Project ?

I decided to work on the "IoT Edge Gateway Solution". I teamed up with one of my classmate for this project and started finding answers of many questions. How will we provide this solution? The answer is, we will provide an application which is very user-friendly and smart. Which will make the INTERNET part and coding part of IoT very easy by just drag & drop or giving very little inputs. This application will be a web-app and mobile app also. For using this app user have to connect their hard-wares to their system through which they can access this app. We will provide some library files/modules for reducing the coding part. By using this app users will be able to control, manage and analyze their things and trigger functionalities. So that's the basic definition and functionalities we decided to work on.

2. What challenge you have faced ?

First of all, I had to make tough choice between IDP and UDP. After visiting many local companies, I realized some incompatibility for working in industry, major issues are same old definitions, no use of futuristic technology, awful timing and paid also. Therefore, I decided to do User Define Project. I refer many websites and take guidance from my faculty guide for finding the definition for my project. After taking all the reference, it was still hard to decide the good definition to work. Because more of the definitions are already well implemented. Finally, after many tries I got a great definition to work which is "IoT Edge Gateway Solution". Since IoT is very challenging field, I needed to study it well. So, I did refer many online tutorials for learning the IoT. Deciding definition wasn't enough just because it's quite hard to implement it all alone. So, I started sharing my idea with classmates and asked some of them to work with me. One of them finally agreed to work with me.

3. What support you need ?

As our project is based on IoTs we need permission to access our lab for basic components like sensors, resistors, capacitors, ICs. We also need some guidance on circuits. We are building web and mobile application, so we need guidance regarding internet part of the IoTs in order to make our project very efficient and easy to use.

4. Which literature you have referred ?

I referred contents from following websites. <http://www.ieeefinalyearprojects.org/domain.html>
<https://www.quora.com/What-is-the-best-domain-to-do-your-final-year-project-in-CSE>

<http://cse.final-year-projects.in/> <http://ieeeproject.org/ieee-projects-cse/cse-final-year-projects/>
<http://ieee-projects-chennai.com/ieee-projects-domains.html>
<http://www.happiestminds.com/solutions/midas-service-platform/>
https://en.wikipedia.org/wiki/Internet_of_things
http://www.happiestminds.com/brochures/M2M_Brochure_0.pdf
<https://www.analyticsvidhya.com/blog/2016/08/10-youtube-videos-explaining-the-real-world-applications-of-internet-of-things-iot/> <https://www.ibm.com/blogs/internet-of-things/iot-applications-industries/> http://www.cisco.com/c/en_in/solutions/internet-of-things/overview.html?stickynav=1 I started learning IoT from following website.
<https://www.coursera.org/specializations/iot>

Comments

Comment by Internal Guide :

Okay

Comment by External Guide :

None

Comment by HOD :

None

Comment by Principal :

None

Comment by University Admin :

None

6.1.2 PPR2

College : GOVERNMENT ENGINEERING COLLEGE, SECTOR - 28,
GANDHINAGAR
StudentName : Parmar Deep Ashokkumar
EnrollmentNo : 140130107055 Department : Computer Engineering
MobileNo : 9428013486 Discipline : BE
Email : deep56parmar@hotmail.com Semester : Semester 7

PPR Details

Periodic Progress Report : Second PPR

Project : IoT edge gateway solution

Status : Reviewed

1. What Progress you have made in the Project ?

Our project is based on Internet of Things. So, we first focused on the “Things” part. We decided to work on Arduino development boards and Raspberry Pi development board. Along with basic circuit parts like resistors, capacitors, ICs, LEDs and servo motors and other motors as actuators. We also decided to include mostly used sensors and modules. Our choice is based on popularity of development boards in use and usefulness of modules and sensors and actuators in IoTs. We also started learning Arduino and Raspberry pi platform.

2. What challenge you have faced ?

Since, there are so much options available for hardware development boards. There are Arduinos which provide low power high efficiency and limited frequency for small and cheap solutions. There are dev boards from intel which vary by use and purpose. There are Raspberry pi which provided very high frequency, low power consumption, memory, OS and much more. So, we got confused what to choose to work on and support via our platform.

3. What support you need ?

It would be very nice if somehow, we got our hands on the actuators and sensors which are mostly available in each ELE. Lab. We also need good guidance in order to get ahead in our work.

4. Which literature you have referred ?

I referred contents from following websites.

http://www.happiestminds.com/brochures/M2M_Brochure_0.pdf <https://www.arduino.cc/>

<https://www.raspberrypi.org/products/raspberry-pi-3-model-b/>

<https://www.intel.com/content/www/us/en/internet-of-things/infographics/iot-platform-infographic.html> I started learning Arduino and Raspberry Pi from following website.

<https://www.coursera.org/specializations/iot>

Comments

Comment by Internal Guide :

Okay Fine

Comment by External Guide :

None

Comment by HOD :

None

Comment by Principal :

None

Comment by University Admin :

None

6.1.3 PPR₃

College : GOVERNMENT ENGINEERING COLLEGE, SECTOR - 28,
GANDHINAGAR
StudentName : Parmar Deep Ashokkumar
EnrollmentNo : 140130107055 Department : Computer Engineering
MobileNo : 9428013486 Discipline : BE
Email : deep56parmar@hotmail.com Semester : Semester 7

PPR Details

Periodic Progress Report : Third PPR

Project : IoT edge gateway solution

Status : Reviewed

1. What Progress you have made in the Project ?

In this project, we are going to build a web application in “internet” part of the IoTs. We are going to use Angular JS/Bootstrap as a front end of our web-app. Which provide very good flexibility and variety in design so that we can build our app way more attractive. It also provides very excellent UX. We will use Node.JS as a back-end of our web application. The reason behind choosing the node.js is, it is compatible with FIREBASE and most of API which we are going to use in this project. For deployment of this app we will use either FIREBASE or HEROKU servers. Because they are very cheap solution, nearly free of charge.

2. What challenge you have faced ?

There are many programming languages and frameworks are available for the front-end and back-end development. For front-end REACT.JS, angular.js, bootstrap, WordPress and many other. At backend there are Ruby, PHP, JAVA, Node.js, .NET, Python. We really confused about choosing the right choice. After searching a lot, we compare each and every possibility for better choice. Then we select Node.js for backend for its speed, community support, and it's really near to latest technology.

3. What support you need ?

For developing the web app, I need a front-end developer, I am basically good at the backend development. So, it would be very nice if my project partner is very good at the front-end development. We also need some guidance about deploying the web application.

4. Which literature you have referred ?

I referred contents from following websites. <https://www.heroku.com/free>
<https://firebase.google.com/pricing/> <https://www.sitepoint.com/sitepoint-smackdown-php-vs-node-js/> <https://medium.com/unexpected-token/10-weeks-of-node-js-after-10-years-of-php-a352042c0c11> I started learning Node.js and angular, Bootstrap from following website. <https://www.pluralsight.com/> <https://www.lynda.com/>

Comments

Comment by Internal Guide :

good

Comment by External Guide :

None

Comment by HOD :

None

Comment by Principal :

None

Comment by University Admin :

None

6.1.4 PPR4

College : GOVERNMENT ENGINEERING COLLEGE, SECTOR - 28,
GANDHINAGAR
StudentName : Parmar Deep Ashokkumar
EnrollmentNo : 140130107055 Department : Computer Engineering
MobileNo : 9428013486 Discipline : BE
Email : deep56parmar@hotmail.com Semester : Semester 7

PPR Details

Periodic Progress Report : Forth PPR

Project : IoT edge gateway solution

Status : Reviewed

1. What Progress you have made in the Project ?

We also thought about making our platform available for mobile devices. We are going to build the same application for mobile devices. At first, we will make app for android platform. Because android platform is pretty much easy to develop and use. From a survey of mobile users 70% of mobile users are Android users. For deployment of our app we may be use remote MYSQL or Firebase application for it. We are going to use some relevant Google APIs for our app.

2. What challenge you have faced ?

Deciding android platform was easy but deciding version for which our app is available, very tough. Because new version comes with new features. Deploying app on store with backend and database with some cloud services. Finding a service provider wasn't that easy with low price.

3. What support you need ?

Developing an android app is easy, with good guidance and some tech support from community. It would be nice if my team give a little hand on UI for android. Because I can really use their support.

4. Which literature you have referred ?

I referred contents from following websites. <https://firebase.google.com/>
<https://developer.android.com/index.html> I started learning android from following website.
<https://www.udacity.com/> <https://www.lynda.com/>

Comments

Comment by Internal Guide :

fine okay

Comment by External Guide :

None

Comment by HOD :

None

Comment by Principal :



None

Comment by University Admin :

None

6.2. PSAR

6.2.1 PSAR₁

| | | |
|--|--|---|
|  | <p style="text-align: center;">GUJARAT TECHNOLOGICAL UNIVERSITY (GTU) INNOVATION COUNCIL (GIC) Patent Search & Analysis Report (PSAR)</p> |  |
| Date of Submission : 24/08/2017 | | |
| Dear Parmar Deep Ashokkumar, | | |
| Studied Patent Number for generation of PSAR : 17BE7_140130107055_1 | | |
| PART 1: PATENT SEARCH DATABASE USED | | |
| 1. Patent Search Database used : Google Advance Patents | | |
| Web link of database : https://www.google.co.in/advanced_patent_search | | |
| 2. Keywords Used for Search : Internet of Things,gateway,edge | | |
| 3. Search String Used : "Iot edge gateway" | | |
| 4. Number of Results/Hits getting : 57 | | |
| PART 2: BASIC DATA OF PATENTED INVENTION /BIBLIOGRAPHIC DATA | | |
| 5. Category/ Field of Invention : | | |
| 6. Invention is Related to/Class of Invention : Internet of things , Cloud Computing | | |
| 6 (a) : IPC class of the studied patent : H04L 67/16 | | |
| 7. Title of Invention : Discovering cloud-based services for IOT devices in an IOT network associated with a user | | |
| 8. Patent No. : | | |
| 9. Application Number : US14550595 | | |
| 9 (a) : Web link of the studied patent : https://patents.google.com/patent/US20150156266A1/en | | |
| 10. Date of Filing/Application (DD/MM/YYYY) : 11/21/2014 | | |
| 11. Priority Date (DD/MM/YYYY) : 11/29/2104 | | |
| 12. Publication/Journal Number : US 2015/0156266 | | |
| 13. Publication Date (DD/MM/YYYY) : 06/04/2014 | | |
| 14. First Filled Country : Albania : 284 | | |
| Page 1 | | |

15. Also Published as

| Sr.No | Country Where Filled | Application No./Patent No. |
|-------|----------------------|----------------------------|
| 1 | United States | US14550595 |

16. Inventor/s Details.

| Sr.No | Name of Inventor | Address/City/Country of Inventor |
|-------|------------------|----------------------------------|
| 1 | Binita Gupta | San Diego |

17. Applicant/Assignee Details.

| Sr.No | Name of Applicant/Assignee | Address/City/Country of Applicant |
|-------|----------------------------|-----------------------------------|
| 1 | QUALCOMM Incorporated | San Diego |

18. Applicant for Patent is : Company

PART 3: TECHNICAL PART OF PATENTED INVENTION**19. Limitation of Prior Technology / Art**

Here in this patent the inventor described well methods to discovering cloud based services for iot devices associated with user. Here we are using meta-data for request for a service from IoT devices/class, to provide service described in that meta-data. With prior technology we have to send request with data attached related to compatibility and authentication issues will be always there for users. Sometimes lot will get the cloud service response which is not compatible with the current IoT device.

20. Specific Problem Solved / Objective of Invention

Tagging meta-data of the lot device/class for a request is the best idea to solve the authentication and compatibility issues. With tagged meta-data cloud service provider have to find at least one service for response. So IoT device will get at least one response from service provider. Here lot devices can connect with each other to form classes and make certain criteria for services. Here we are using cloud services which gives many features like QoS, On demand service. According to this pattern we are going to use the wired or wireless tech for connections. Here IoT super Agent works as a gateway which will provide solution for P2P connections and certain security issues.

21. Brief about Invention

This invention is about how to discover cloud services for iot devices. According to this patent main components are lot devices, Internet and Cloud service providers and publishers. About roles of each components, we can say that lot devices work like clients which request for needed service, Cloud service provider will provide that service through service publishers and internet is the medium for this conversation. In flow first of all the lot device will send a request for a service if it is auto activate then service provider find that service and response. otherwise if it is not auto activate then authentication

22. Key learning Points

Methods for discovering a nearly perfect service to provide.
Using of meta data for ease.
Offer a discovered cloud-based service.

23. Summary of Invention

This patent relates to discovering and offering cloud-based services for Internet of Things, devices in an IoT network. In particular, an IoT gateway or other device/class can discover information about the IoT devices in the IoT network, discover cloud-based services tagged with discovered information, and offer the discovered cloud-based services in the IoT network. In response to receiving a request to invoke a discovered cloud-based service from an IoT device and/or a user associated with the IoT network, the IoT gateway connect to the appropriate IoT devices and fetch data associated with the requested cloud-based services, pass the fetched data to publisher/I providers associated with the requested cloud-based services, and give a result from the invoked cloud-based services to the IoT devices in the IoT network.

24. Number of Claims : 30

25. Patent Status : Published Application

26. How much this invention is related with your IDP/UDP?



< 70 %

27. Do you have any idea to do anything around the said invention to improve it? (Give short note in not more than 500 words)

According to this pattern there is Peer to peer connection occur. And we are using meta data consisting information regarding IoT devices. Somehow I found that very suspicious in context of security. There are chances for misuse of data and security breaches for IoTs. We can add more security to improve this innovation.

Page 3

6.2.2 PSAR₂

| | | |
|---|---|---|
|  | GUJARAT TECHNOLOGICAL UNIVERSITY (GTU) INNOVATION COUNCIL (GIC) Patent Search & Analysis Report (PSAR) |  |
| Date of Submission : 28/08/2017 | | |
| Dear Parmar Deep Ashokkumar, Studied Patent Number for generation of PSAR : 17BE7_140130107055_2 | | |
| PART 1: PATENT SEARCH DATABASE USED | | |
| 1. Patent Search Database used | : | Google Patents |
| Web link of database | : | https://patents.google.com/ |
| 2. Keywords Used for Search | : | IOT,edge,secure gateway |
| 3. Search String Used | : | IoT Edge Secure Gateway |
| 4. Number of Results/Hits getting | : | 1507 |
| PART 2: BASIC DATA OF PATENTED INVENTION /BIBLIOGRAPHIC DATA | | |
| 5. Category/ Field of Invention | : | |
| 6. Invention is Related to/Class of Invention | : | Internet of things , Security |
| 6 (a) : IPC class of the studied patent | : | H04L 12/66 |
| 7. Title of Invention | : | Apparatus and method for using an internet of things edge secure gateway |
| 8. Patent No. | : | |
| 9. Application Number | : | US14963013 |
| 9 (a) : Web link of the studied patent | : | https://patents.google.com/patent/US20170163444A1/en |
| 10. Date of Filing/Application (DD/MM/YYYY) | : | 12/08/2015 |
| 11. Priority Date (DD/MM/YYYY) | : | |
| 12. Publication/Journal Number | : | US 2017/0163444 A1 |
| 13. Publication Date (DD/MM/YYYY) | : | 06/08/2017 |
| 14. First Filled Country : Albania | : | 284 |

15. Also Published as

| Sr.No | Country Where Filled | Application No./Patent No. |
|-------|----------------------|----------------------------|
| 1 | United States | US14963013 |

16. Inventor/s Details.

| Sr.No | Name of Inventor | Address/City/Country of Inventor |
|-------|-------------------|----------------------------------|
| 1 | Paul F McLaughlin | Ambler |
| 2 | James Strilich | PA (US) |
| 3 | Andrew Duca | Phoenix |
| 4 | Ellen B Hawkinson | AZ (US) |
| 5 | Joseph Felix | Phoenix |

17. Applicant/Assignee Details.

| Sr.No | Name of Applicant/Assignee | Address/City/Country of Applicant |
|-------|-----------------------------|-----------------------------------|
| 1 | HONEYWELL INTERNATIONAL INC | MORRIS PLAINS |

18. Applicant for Patent is : Company

PART 3: TECHNICAL PART OF PATENTED INVENTION**19. Limitation of Prior Technology / Art**

In Internet of things security is the most important aspect to deal with. There are multiple solutions available. But no one is perfectly secure. Everyone has its own benefits and drawbacks. Sometimes if we increase security we lose speed. There's a trade off between security and performance terms.

20. Specific Problem Solved / Objective of Invention

This innovation provides us a method to use a gateway in a more secure manner. Objective of this innovation is to recognize different protocols corresponding to different IoT devices and transfer data from one protocol to another and provide security.

21. Brief about Invention

A gateway is configured to perform a method that includes receiving data from a first device using a first protocol. The first protocol is a cloud-based protocol. The method also includes determining that the received data is intended for a second device that uses a second protocol. The method further includes converting the received data from the first protocol to the second protocol. In addition, the method includes transmitting the received data to the second device via the second protocol.

22. Key learning Points

Using multiple protocols
using a secure IoT gateway.

23. Summary of Invention

In a gateway, data from a first device regarding a first protocol is received and then we find the corresponding second device which is in need of that data. Then this data is converted regarding the other protocol and is sent to the second device. The same also happens when a second device requests. The first protocol is a cloud-based protocol.

24. Number of Claims : 20

25. Patent Status : Published Application

26. How much this invention is related with your IDP/UDP?

Page 2



< 70 %

27. Do you have any idea to do anything around the said invention to improve it? (Give short note in not more than 500 words)

This patent is quite good but we can still improve it by using some encryption algorithms which are powerful and fast. Otherwise this patent provide very good methods for using lot secure gateway.

Page 3

6.2.3 PSAR₃

| | | |
|---|---|---|
|  | GUJARAT TECHNOLOGICAL UNIVERSITY (GTU) INNOVATION COUNCIL (GIC) Patent Search & Analysis Report (PSAR) |  |
| Date of Submission : 28/08/2017 | | |
| Dear Parmar Deep Ashokkumar, Studied Patent Number for generation of PSAR : 17BE7_140130107055_3 | | |
| PART 1: PATENT SEARCH DATABASE USED | | |
| 1. Patent Search Database used | : | Google Patents |
| Web link of database | : | https://patents.google.com/ |
| 2. Keywords Used for Search | : | Architecture,lot ,Devices |
| 3. Search String Used | : | "Architecture for iot devices" |
| 4. Number of Results/Hits getting | : | 4274 |
| PART 2: BASIC DATA OF PATENTED INVENTION /BIBLIOGRAPHIC DATA | | |
| 5. Category/ Field of Invention | : | |
| 6. Invention is Related to/Class of Invention | : | Architecture , Internet of Things |
| 6 (a) : IPC class of the studied patent | : | H04L 41/046 |
| 7. Title of Invention | : | Containerized architecture to manage internet-connected devices |
| 8. Patent No. | : | |
| 9. Application Number | : | US15270948 |
| 9 (a) : Web link of the studied patent | : | https://patents.google.com/patent/US20170099176A1/en |
| 10. Date of Filing/Application (DD/MM/YYYY) | : | 09/20/2016 |
| 11. Priority Date (DD/MM/YYYY) | : | |
| 12. Publication/Journal Number | : | |
| 13. Publication Date (DD/MM/YYYY) | : | |
| 14. First Filled Country : Albania | : | 284 |

15. Also Published as

| Sr.No | Country Where Filled | Application No./Patent No. |
|-------|----------------------|----------------------------|
| 1 | | |

16. Inventor/s Details.

| Sr.No | Name of Inventor | Address/City/Country of Inventor |
|-------|------------------|---|
| 1 | Sandeep Jain | Mobile Iron INC. Mountain View, CA,(US) |

17. Applicant/Assignee Details.

| Sr.No | Name of Applicant/Assignee | Address/City/Country of Applicant |
|-------|----------------------------|-----------------------------------|
| 1 | Mobile Iron INC | Mountain View, CA,(US) |

18. Applicant for Patent is : Company

PART 3: TECHNICAL PART OF PATENTED INVENTION**19. Limitation of Prior Technology / Art**

There are many problems related to IoT technology. Security, Database Management, Hardware/software management, action triggering etc. There was no such standard architecture which solve these all problems regarding managing the lots with minimizing all the problems like security.

20. Specific Problem Solved / Objective of Invention

We can use this invention in many ways. It provides isolated, resource controlled and portable environment in which to run apps, application or other code. Sensors and actuators are provided network connectivity via IoT gateway. Software can be install in gateway to provision, secure and managed gateway.

21. Brief about Invention

According to this patent this invention is about an architecture which is helpful to manage IoT devices. There is management server which is connected to IoT gateway. In which there are apps, sensors, and Edge agent. Security proxy is also a part of this architecture. Which is connected to IoT gateway. Through which client can access services.

22. Key learning Points

Well managed architecture, Multiple use of one invention, how to manage IoT devices by using IoT Gateway and Edge agents with software application which is secure.

23. Summary of Invention

At first, we have to register IoT Gateway and deploy it. We have to connect it to the management server. Then install edge agent on gateway. Install multiple apps and sensors and actuators. If we want to change settings for application or driver, we can do it via Edge Agent. If there are trigger or threshold events, we also can manage through IoT gateway.

24. Number of Claims : 20

25. Patent Status : Published Application

26. How much this invention is related with your IDP/UDP?



< 70 %

27. Do you have any idea to do anything around the said invention to improve it? (Give short note in not more than 500 words)

This is a very good architecture indeed. Currently I can't suggest any specific idea to improve this architecture.

Page 2

6.2.4 PSAR₄

| | | |
|---|---|---|
|  | GUJARAT TECHNOLOGICAL UNIVERSITY (GTU) INNOVATION COUNCIL (GIC) Patent Search & Analysis Report (PSAR) |  |
| Date of Submission : 30/08/2017 | | |
| Dear Parmar Deep Ashokkumar, Studied Patent Number for generation of PSAR : 17BE7_140130107055_4 | | |
| PART 1: PATENT SEARCH DATABASE USED | | |
| 1. Patent Search Database used | : | Google Patents |
| Web link of database | : | https://patents.google.com/ |
| 2. Keywords Used for Search | : | object,recognition, IOT |
| 3. Search String Used | : | "Object Recognition" |
| 4. Number of Results/Hits getting | : | 5199 |
| PART 2: BASIC DATA OF PATENTED INVENTION /BIBLIOGRAPHIC DATA | | |
| 5. Category/ Field of Invention | : | |
| 6. Invention is Related to/Class of Invention | : | IoT Object Recognition |
| 6 (a) : IPC class of the studied patent | : | G06K 9/3241 |
| 7. Title of Invention | : | Technologies for object recognition for internet-of-things edge devices |
| 8. Patent No. | : | |
| 9. Application Number | : | US14851094 |
| 9 (a) : Web link of the studied patent | : | https://patents.google.com/patent/US20170076168A1/en |
| 10. Date of Filing/Application (DD/MM/YYYY) | : | 09/11/2016 |
| 11. Priority Date (DD/MM/YYYY) | : | |
| 12. Publication/Journal Number | : | |
| 13. Publication Date (DD/MM/YYYY) | : | |
| 14. First Filled Country : Albania | : | |

15. Also Published as

| Sr.No | Country Where Filled | Application No./Patent No. |
|-------|----------------------|----------------------------|
| 1 | United States | US14851094 |

16. Inventor/s Details.

| Sr.No | Name of Inventor | Address/City/Country of Inventor |
|-------|------------------|----------------------------------|
| 1 | Bradut Vrabete | Sixmilebridge (IE) |

17. Applicant/Assignee Details.

| Sr.No | Name of Applicant/Assignee | Address/City/Country of Applicant |
|-------|----------------------------|-----------------------------------|
| 1 | Intel Corporation | Santa Clara, CA(US) |

18. Applicant for Patent is : Company

PART 3: TECHNICAL PART OF PATENTED INVENTION**19. Limitation of Prior Technology / Art**

First issue with prior technology is, IoTs at the edge are often low at bandwidth. And highspeed networks are costly. For object recognition, algorithms are dependent on huge reference image database. Complexity of these algorithms are way too high. So these are the problems with prior technology.

20. Specific Problem Solved / Objective of Invention

According to this patent, task for recognition of object is divided in two modules. Edge devices and server. Edge devices also include reduced object recognition database. Where server includes main database, and reduced object recognition database. By reduced object recognition database, edge devices can recognize object directly. So, the bandwidth problem is solved. And recognize and object through reduced object database is way to faster.

21. Brief about Invention

This application requires server and multiple edge devices connected over a network. The server maintains the database for object recognition. Then the server identifies the subset of objects that is going to recognize by the edge device. After any event, the recognition task happens. If it is not recognized the image is sent to the server and then server do the recognition task.

22. Key learning Points

Use a good architecture scheme can be beneficial. Not all devices have to recognize all objects of the world, so we can make a database for expected ones.

23. Summary of Invention

object recognition includes server and edge devices in communication over network. The server maintains object recognition database that stores images. The server identifies a subset of the objects that is expected to be recognized by each of the edge devices and generates a reduced object recognition database. Each edge device monitors for device events and, in response to a device event, performs object recognition using reduced object recognition database. The edge device may transmit images of unrecognized objects to the server.

24. Number of Claims : 24

25. Patent Status : Published Application

26. How much this invention is related with your IDP/UDP?

Not related to IDP/UDP, It's related to my area of interest

27. Do you have any idea to do anything around the said invention to improve it? (Give short note in not more than 500 words)



Machine learning is the key answer to this question. We can apply better algorithms by using machine learning and deep learning to recognize

Page 2

the objects. That's how we can improve the current patent.

Page 3

6.2.5 PSAR₅

| | | |
|--|---|---|
|  | GUJARAT TECHNOLOGICAL UNIVERSITY (GTU) INNOVATION COUNCIL (GIC) Patent Search & Analysis Report (PSAR) |  |
| Date of Submission : 30/08/2017 | | |
| Dear Parmar Deep Ashokkumar, | | |
| Studied Patent Number for generation of PSAR : 17BE7_140130107055_5 | | |
| PART 1: PATENT SEARCH DATABASE USED | | |
| 1. Patent Search Database used : Google Patents | | |
| Web link of database : https://patents.google.com/ | | |
| 2. Keywords Used for Search : IOT,edge,Gateway | | |
| 3. Search String Used : "IoT Edge Gateway" | | |
| 4. Number of Results/Hits getting : 3490 | | |
| PART 2: BASIC DATA OF PATENTED INVENTION /BIBLIOGRAPHIC DATA | | |
| 5. Category/ Field of Invention : | | |
| 6. Invention is Related to/Class of Invention : IoT Cloud Database | | |
| 6 (a) : IPC class of the studied patent : G06F8/70 | | |
| 7. Title of Invention : Edge Intelligence Platform, and Internet of Things Sensor Streams System | | |
| 8. Patent No. : | | |
| 9. Application Number : US15250720 | | |
| 9 (a) : Web link of the studied patent : https://patents.google.com/patent/US20170060574A1/en | | |
| 10. Date of Filing/Application (DD/MM/YYYY) : 08/29/2016 | | |
| 11. Priority Date (DD/MM/YYYY) : | | |
| 12. Publication/Journal Number : | | |
| 13. Publication Date (DD/MM/YYYY) : | | |
| 14. First Filled Country : Albania : | | |

15. Also Published as

| Sr.No | Country Where Filled | Application No./Patent No. |
|-------|----------------------|----------------------------|
| 1 | | |

16. Inventor/s Details.

| Sr.No | Name of Inventor | Address/City/Country of Inventor |
|-------|------------------------|----------------------------------|
| 1 | Sastry KM Malladi | United States |
| 2 | Thirimalai Muppur Ravi | United States |
| 3 | Mohan Komalla Reddy | United Staes |
| 4 | Kamlesh Raghvendra | India |

17. Applicant/Assignee Details.

| Sr.No | Name of Applicant/Assignee | Address/City/Country of Applicant |
|-------|----------------------------|-----------------------------------|
| 1 | FogHorn Systems INC | United States |

18. Applicant for Patent is : Company

PART 3: TECHNICAL PART OF PATENTED INVENTION**19. Limitation of Prior Technology / Art**

In a prior technology, large amount of data generated by the industrial machines cannot be managed easily . Distance between client and data may be far far away. The industrial Internet of things (IIoT) uses a collection of devices that relies on instrumentation of the physical operations with sensors that track events with very high frequency. It is not practical to send all of that data to cloud storage because there are connectivity problem, bandwidth problem, or it is cost prohibitive even if bandwidth exists.then also, bandwidth, and cost are not issues, there is no real-time decision making and predictive.

20. Specific Problem Solved / Objective of Invention

The invention is about edge computing to handle the large amounts of data generated by industrial machines, For improving computing systems, architectures, and techniques including improved edge analytic are needed to handle large amounts of data generated by industrial machines.so that this system is enabling intelligence at the edge. In feature, triggering by sensor data in a software layer hosted on either a gateway device or an embedded system.

21. Brief about Invention

Multiple sensor data and a software layer physically connected between the multiple of sensors and a communication network, the software layer is configured to perform computations based on data received from the sensors. Software layer includes a programmable virtual sensor from a viewpoint of the data processing layer and communication network. software includes data processing layer including a complex event processing engine and an expression language for stream processing. Then, software layer use data publication using getaway.at here analysis function work and data will Analyse. It will give real time result

22. Key learning Points

Cloud management, Real time database analysis and management, Remote monitoring ,operational intelligence.

23. Summary of Invention

this invention for enabling intelligence at the edge. It includes triggering by sensor data in a software layer hosted on either a gateway device or an embedded system. Software layer make an expression language which is use by language Matching the sensor data with semantic descriptions of occurrence of specific conditions. Automatic discovery of pattern events by continuously executing expressions. Intelligently composing services and applications across the gateway device and embedded systems across the network managed by the software layer for chaining applications and analytics expressions. Optimizing the layout of the applications and analytics based on resource availability. Storing of raw sensor data of expressions in a local time-series database or cloud storage. So that Services and components can be containerized to ensure smooth running in any gateway environment.

24. Number of Claims

:

25

25. Patent Status

:

Published Application

26. How much this invention is related with your IDP/UDP?

< 70 %

27. Do you have any idea to do anything around the said invention to improve it? (Give short note in not more than 500 words)

Data science and machine learning can be the answer for improving this patent. There are many algorithms in which we can easily get real time data in data science by machine learning.

Page 3

6.2.6 Comments

sdic_tutorial.pdf
modular approach - Goog
Custom Code - myDevice:
07092015.pdf
PeriodicProgressReportBy
PSARByStudents

pmms1.gtu.ac.in/Student/StudentActivity/PSARByStudents

Name : Parmar Deep Ashokkumar
College : GOVERNMENT ENGINEERING COLLEGE, SECTOR - 28, GANDHINAGAR
Enrollment No : 140130107055 **Department** : Computer Engineering
Mobile No : 9428013486 **Discipline** : BE
Email Id : deep56parmar@hotmail.com **Semester** : Semester 7

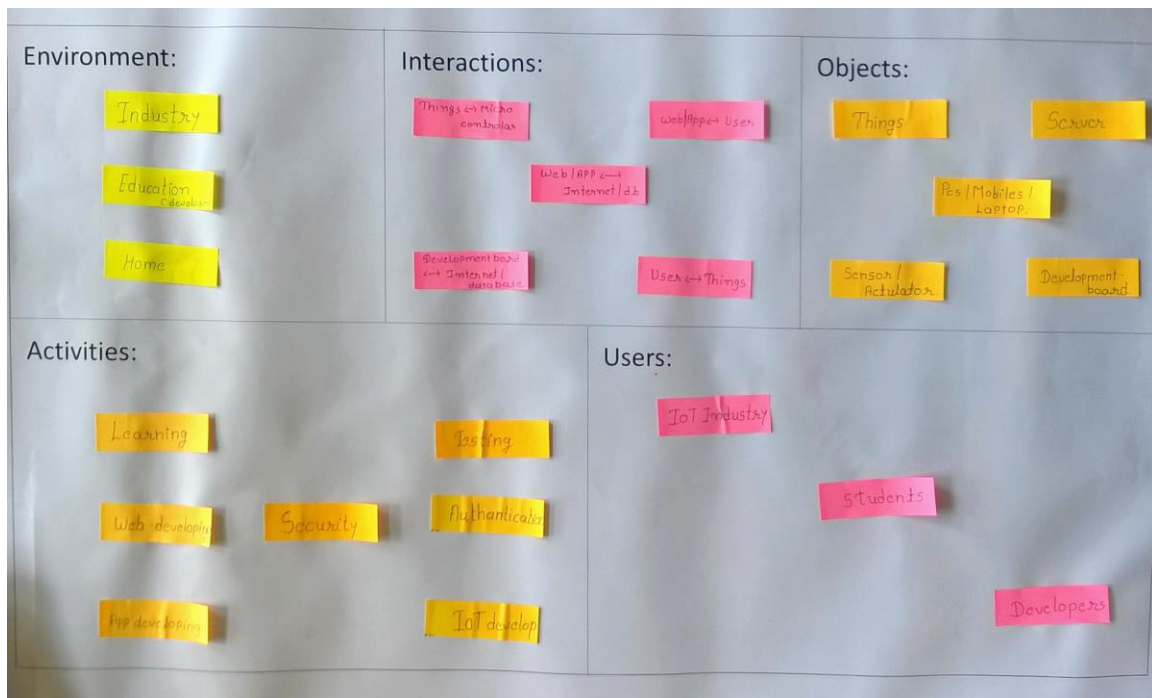
Project Name : IoT edge gateway solution
Team ID : 2849

Note : You have to submit PSAR in chronological order only. For e.g. you cannot submit 5th PSAR, until you submit First PSAR, Second PSAR, Third PSAR and Fourth PSAR.

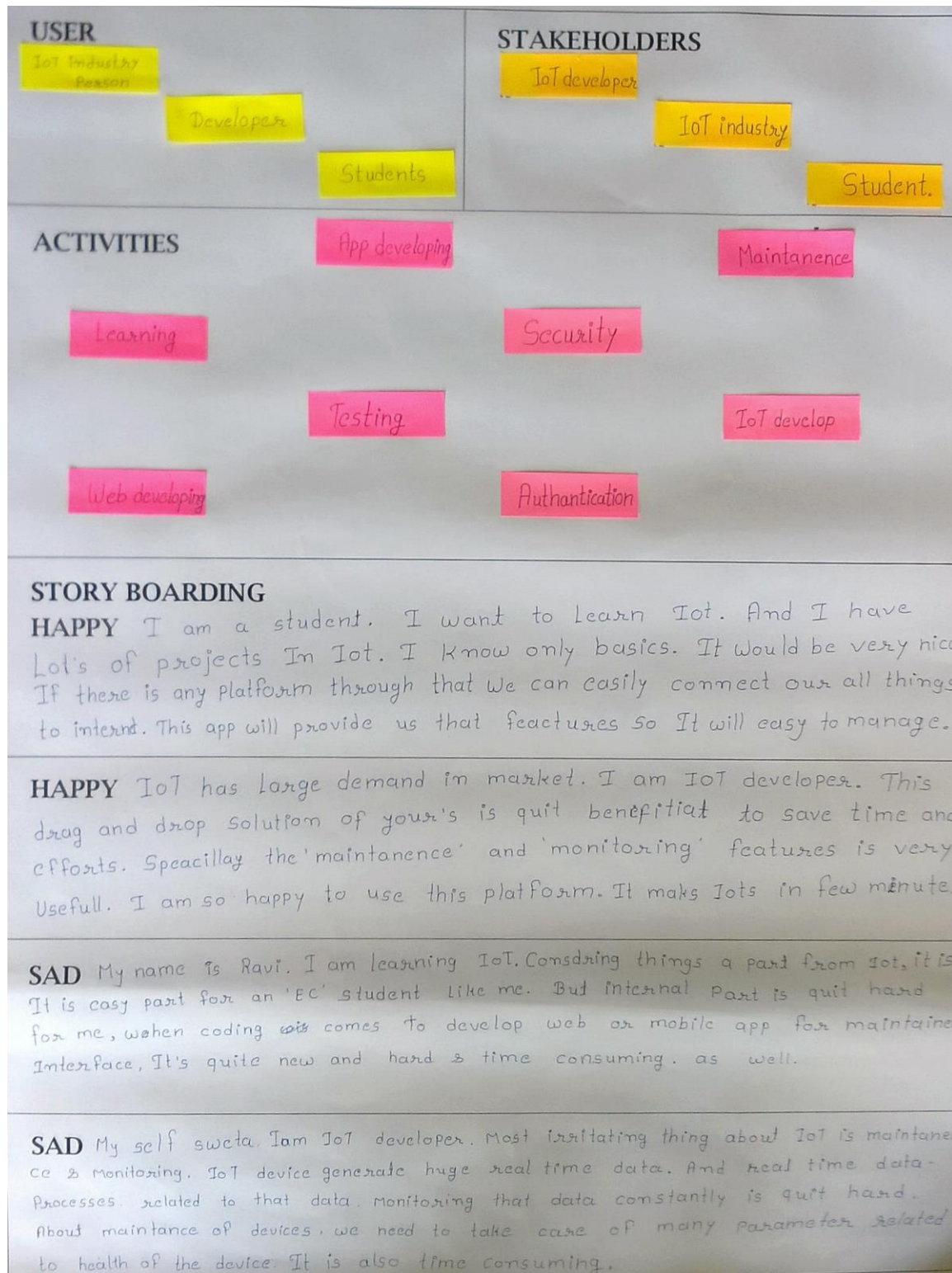
| Sr. No | Title of Invention | Patent No. | Application No. | Status | Comment by Internal Guide | All Comments | Update PSAR | View | Download |
|--------|---|------------|-----------------|----------|---------------------------|--------------|-------------|------|----------|
| 1 | Discovering cloud-based services for iot devices in an iot network associated with a user | | US14550595 | Reviewed | Fine | View | | View | Download |
| 2 | Apparatus and method for using an internet of things edge secure gateway | | US14963013 | Reviewed | Fine | View | | View | Download |
| 3 | Containerized architecture to manage internet-connected devices | | US15270948 | Reviewed | Fine | View | | View | Download |
| 4 | Technologies for object recognition for internet-of-things edge devices | | US14851094 | Reviewed | ok | View | | View | Download |
| 5 | Edge Intelligence Platform, and Internet of Things Sensor Streams System | | US15250720 | Reviewed | ok | View | | View | Download |

6.3 Design Engineering canvases

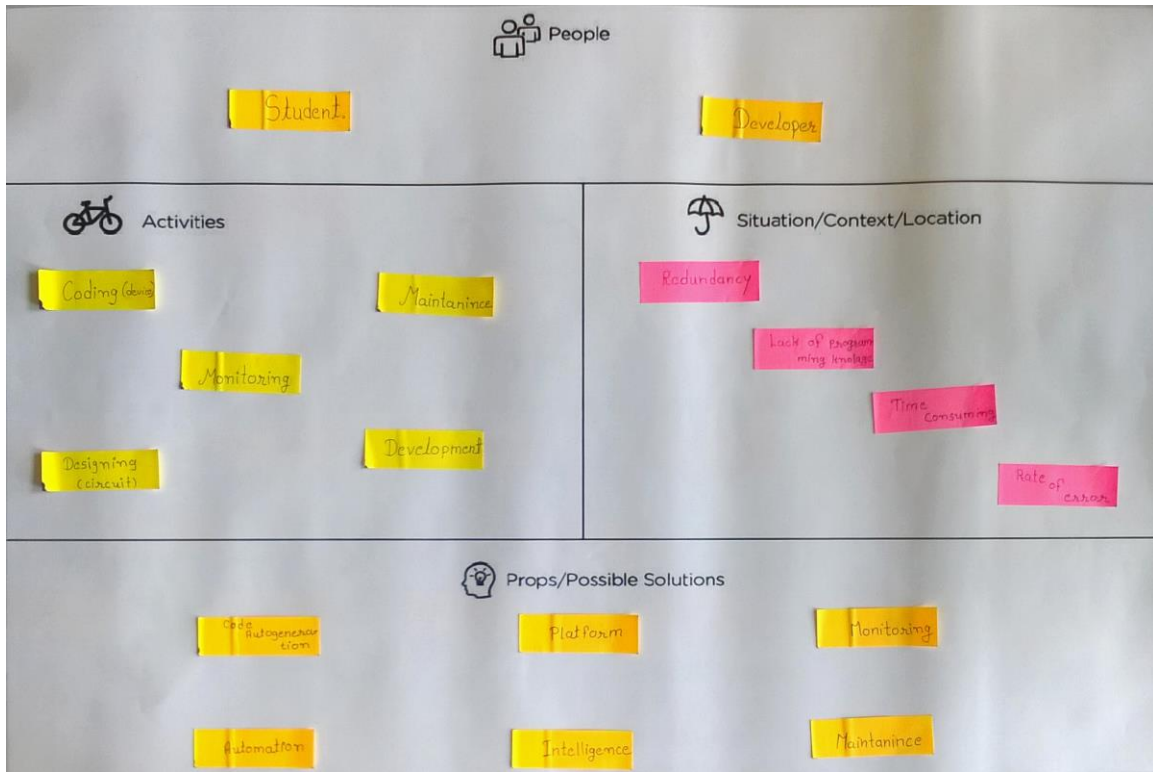
6.3.1 AEIUO Summary Canvas



6.3.2 Empathy Mapping



6.3.3 Ideation Canvas



6.3.4 Production Development Canvas

| | | |
|--|---|----------------------------------|
| Purpose: Service people Automation Intelligence Project maintenance Project Monitoring | Product Experience: | Customer Revalidation: |
| People: IoT Industry Person Developers Students | Product Functions: Auto code Generation Maintenance Monitoring Tagging | |
| | Product Features: Intelligent Real Time data Monitor Auto Code generation Notification Time Saving IoT to a platform | Reject, Redesign, Retain: |
| | Components: Arduino development boards Laptops Raspberry Pi Servers Sensors / Actuators | |