SMART GREENHOUSE

A PROJECT REPORT

Submitted by

PRAJAPATI CHINTAN DINESHBHAI (170410116089)

In fulfillment for the award of the degree

Of

BACHELOR OF ENGINEERING

in

Information Technology

Sardar Vallabhbhai Patel Institute of Technology, VASAD.

Gujarat Technological University, Ahmedabad

May, 2021

SARDAR VALLABHBHAI PATEL INSTITUTE OF TECHNOLOGY, VASAD.

INFORMATION TECHNOLOGY ENGINEERING

2020-21

CERTIFICATE

Date: 15/ 04/ 2021

This is to certify that the Project Work entitled "SMART GREENHOUSE" has been carried out by PRAJAPATI CHINTAN (170410116089), under my guidance in fulfillment of the degree of Bachelor of Engineering in Information Technology (8th Semester) of Gujarat Technological University, Ahmedabad during the academic year 2020-21.

Internal Guide	Head of the Department
Prof. VIRAL PATEL	Dr. B.J.Talati
Asst. Prof.	IT Dept.
SVIT,VASAD	SVIT,VASAD

ACKNOWLEDGMENT

We like to share our sincere gratitude to all those who help us in the completion of this project. During the work, we faced many challenges due to our lack of knowledge and experience but these people help us to get over all the difficulties and in the final compilation of our idea to a shaped sculpture. We would like to express our sincere gratitude to our supervisors Mr. Viral Patel sir, Mr. Amit Kariyani sir & Mr. Anand Patel sir for providing their invaluable guidance, comments, help, and suggestions throughout the project. In the last, We are immensely grated full to all involved in this project as without their inspiration and valuable suggestion it would not have been possible to develop the project within the prescribed time.

Chintan Prajapati (170410116089)

ABSTRACT

This IoT-based smart greenhouse system enables data such as soil moisture and temperature to be collected in real-time and automatically decide whether to water batches of crops, turn on the fan/ bulb. We can preserve a certain humidity and temperature range for optimal plant growth in Smart Greenhouse. Within a few seconds, the sensors will detect changes and report to the custodian. This project would facilitate the cultivation of greenhouse plants. This can be done by using an intelligent greenhouse. It can also reassure you that plants are cared for during holidays or during a longer time around the greenhouse.

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IoT	Internet of things

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1.4 Objective of the new system

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1.8 Project profile

1.9 Advantages and limitations of existing system

1.1 Introduction

- In Smart Greenhouse, we can maintain certain moisture and desired range of temperature for optimal plant growth. Sensors can sense changes in just a few seconds and report to the caretaker.
- This project is to make it easier to grow plants at the greenhouse. This can be achieved with the use of a smart greenhouse.
- Also, it can be reassuring to know that the plants are taken care of while one is on vacation or not around the greenhouse for a longer period.

1.2 Existing System

- In traditional greenhouses it is difficult to take care of temperature and moisture constantly, and in existing Smart Greenhouse system the scalability and cost issues are there.

Traditional Greenhouse

1.3 Need for the New System

- In greenhouse temperature should not go below a certain degree, High humidity can result to crop transpiration, condensation of water vapor on various greenhouse surfaces, and water evaporation from the humid soil. To overcome such challenges, this Smart Greenhouse comes to rescue.

1.4 Objective of the New System

- India is an agrarian country with around 70% of its people depending directly or indirectly upon agriculture.
- The objective is to introduce all the farmers & all the people with Smart Greenhouse and what are the benefits of it.
- Sadly, As per The Wire, 11,379 farmers died by suicide in India in 2016. This translates into 948 suicides every month, or 31 suicides every day.
- The objective is to try to reduce these suicide. We partner with government, and communities to lead the transformation.

1.5 Problem Definition

- To design a system that can maintain certain moisture and desired range of temperature for optimal plant growth automatically.

1.6 Software Process Model

- Spiral Model is a combination of a waterfall model and an iterative model. Each phase in the spiral model begins with a design goal and ends with the client reviewing the progress.
- The development team in the Spiral-SDLC model starts with a small set of requirements and goes through each development phase for those sets of requirements. The software engineering team adds functionality for the additional requirement in every-increasing spirals until the application is ready for the production phase.

1.7 Core Components

- Greenhouse
- Raspberry Pi
- Sensors and Controllers

1.8 Project Profile

Project Name	Smart Greenhouse
Project Type	UDP
Project Definition	To design a system that can maintain certain moisture and desired range of temperature for optimal plant growth automatically. Sensors can sense changes in just a few seconds and report to the caretaker.
Project Domain	IoT

1.9 Advantages and Limitations of the Proposed System

- In greenhouse temperature should not go below a certain degree, High humidity can result to crop transpiration, condensation of water vapor on various greenhouse surfaces, and water evaporation from the humid soil. We can overcome such challenges.
- Also, it can be reassuring to know that the plants are taken care of while one is on vacation or not around the greenhouse for a longer period.
- Provide manual control on sensors is a limitation in a way (Future Implementation).

Chapter 2

Requirement Determination & Analysis

2.1 Requirement Determination

2.1.1 Functional Requirements

- **Interface Requirement**

The system is capable to accept and transmit the raw data which may be in the form of digital that is numeric values.

- **Audit Trail**

For each activity, the data will be recorded in the application audit trail.

- **Capacity**

The system is enough capable to hold the data and process on it.

2.1.2 Non-Functional Requirements

- **Maintainability:**
  Human resources is not required to maintain the components and collect the raw data from each of the components.

- **Reusability:**
  The components are compatible for changing environment and supports upgradeability.

- **Availability:**
  The system is functional throughout and data transfer takes place only when user requests.

- **Usability:**
  The system is user friendly as it uses a simple networking model like a Raspberry Pi .

- **Reliability:**
  The system is highly consistent and reliable.

2.1.3 Hardware Requirements

- Raspberry Pi
- DHT sensor. (eg. DHT11 or DHT22)
- Soil moisture sensor
- Fan, Lightbulb/ heater, Water Pump
- Cables and Connectors
- PCB and Breadboards (Optional maybe)

2.1.4 Software Requirements

- Python or C
- VS code
- ThingSpeak

2.2 Targeted User

- Farmers

Chapter 3

Feasibility Study

3. Feasibility Study

- 3.1 Technical Study
- 3.2 Timeline Chart
- 3.3 Economic Study

3. Feasibility Study

It is to ensure that whether the project is financially and technically feasible. In feasibility study includes analysis of the problem.

There are three tests of Feasibility Study

- Technical Study
- Timeline Chart
- Economic Study

3.1 Technical Study

The technical issue raised during the feasibility stage of checking includes analysing the farmers with the goal to understand how Smart Greenhouse will helpful to people.

3.2 Timeline Chart

Development Phases	**week**													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Analysis														
Design														
Coding														
Testing														
Documentation														

3.3 Economic Study

In that, issue raised during the initiatory checking are for the purpose of estimating the Proper System will require.

The economic study is depends on,

- **Costs:**

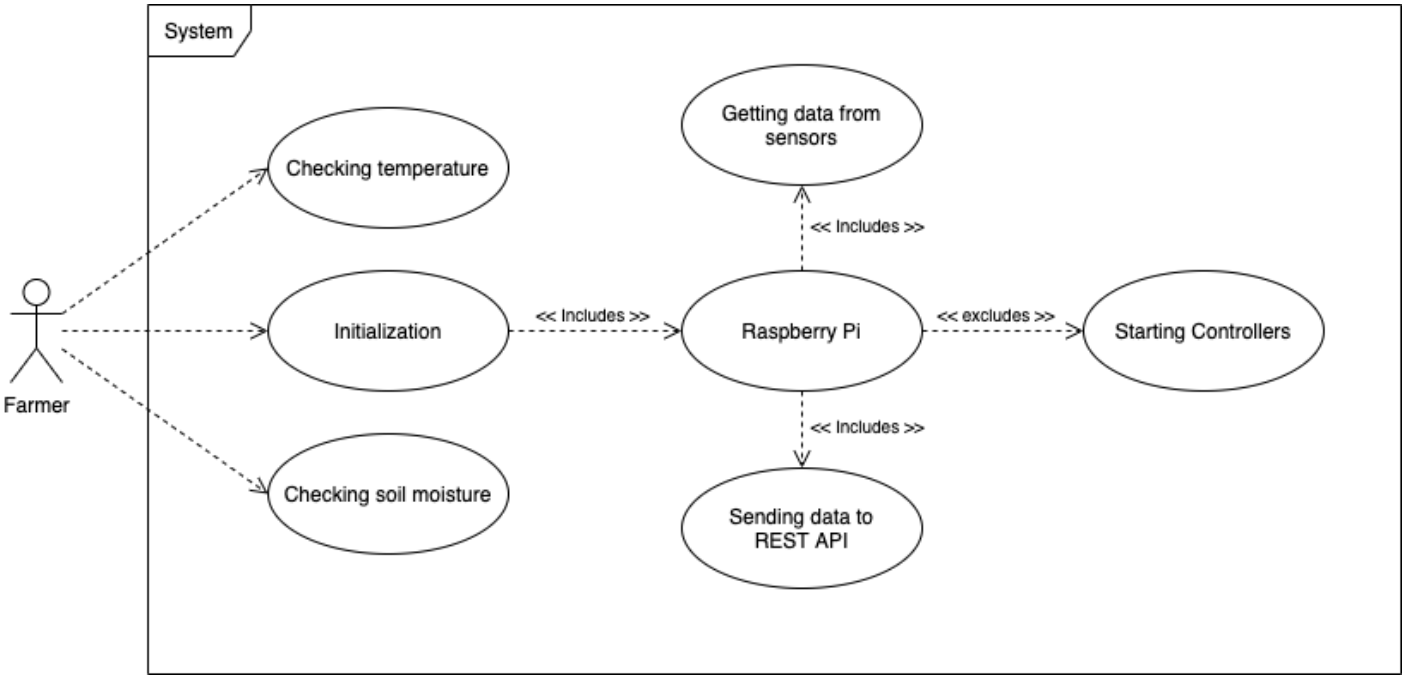
  project cost is medium since the tools and technologies used are not available online. So, we have to buy hardware which is bit costly. It's a group project so there are no personal costs. Development time is planned and will not affect other operation and activities of the individuals.

- **Benefits:**
  1. Performance Benefits:
     - Time saving
     - Less hard labour work

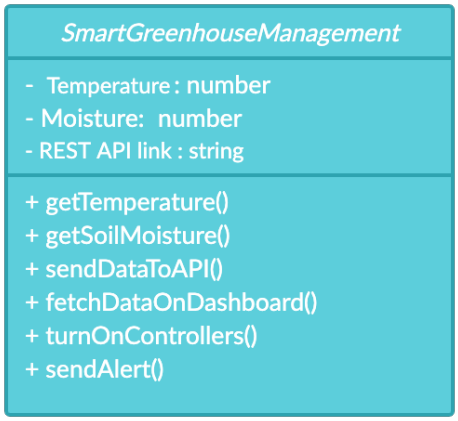
Chapter 4

System Design

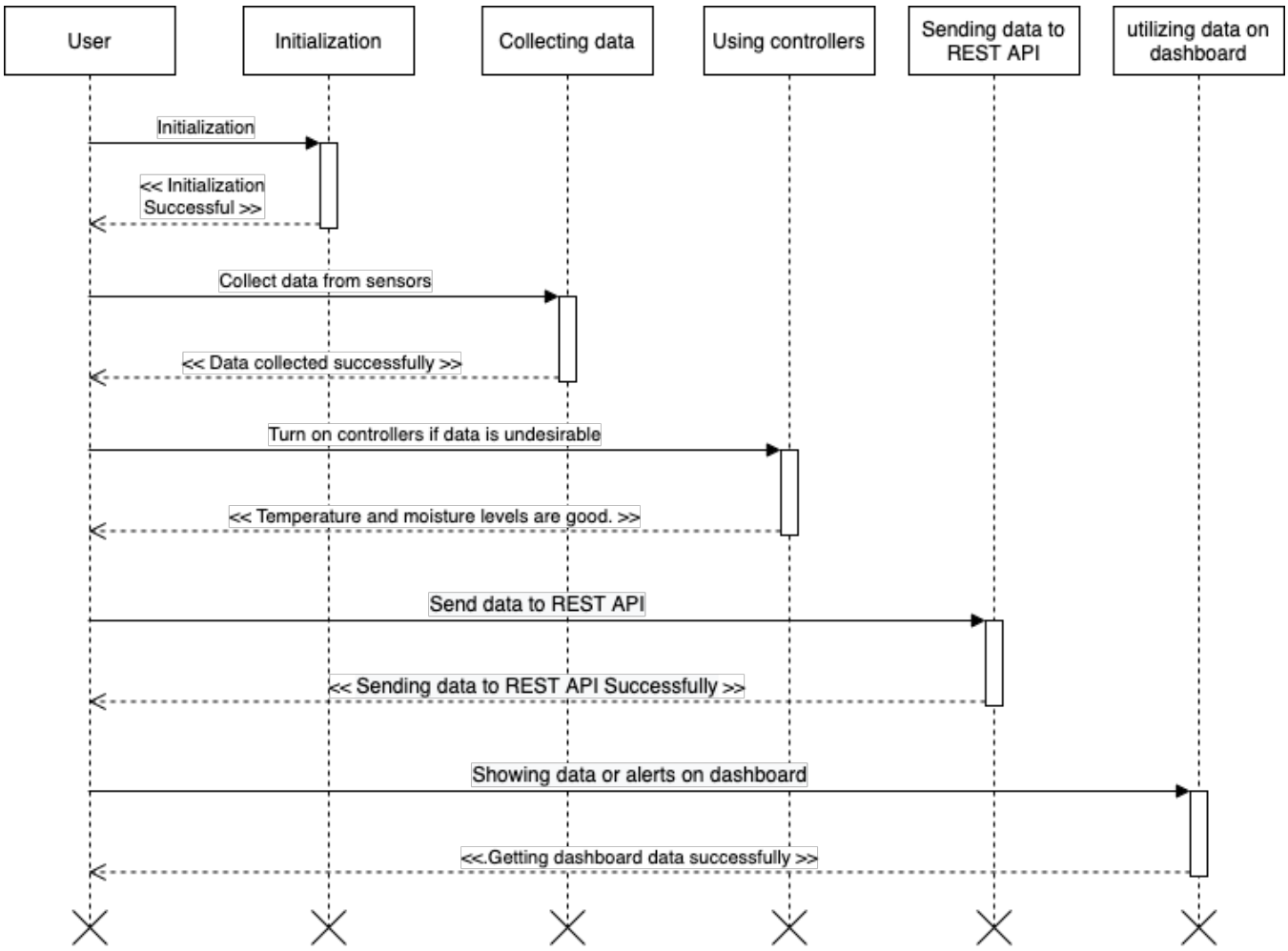
4.1 Use Case Diagram



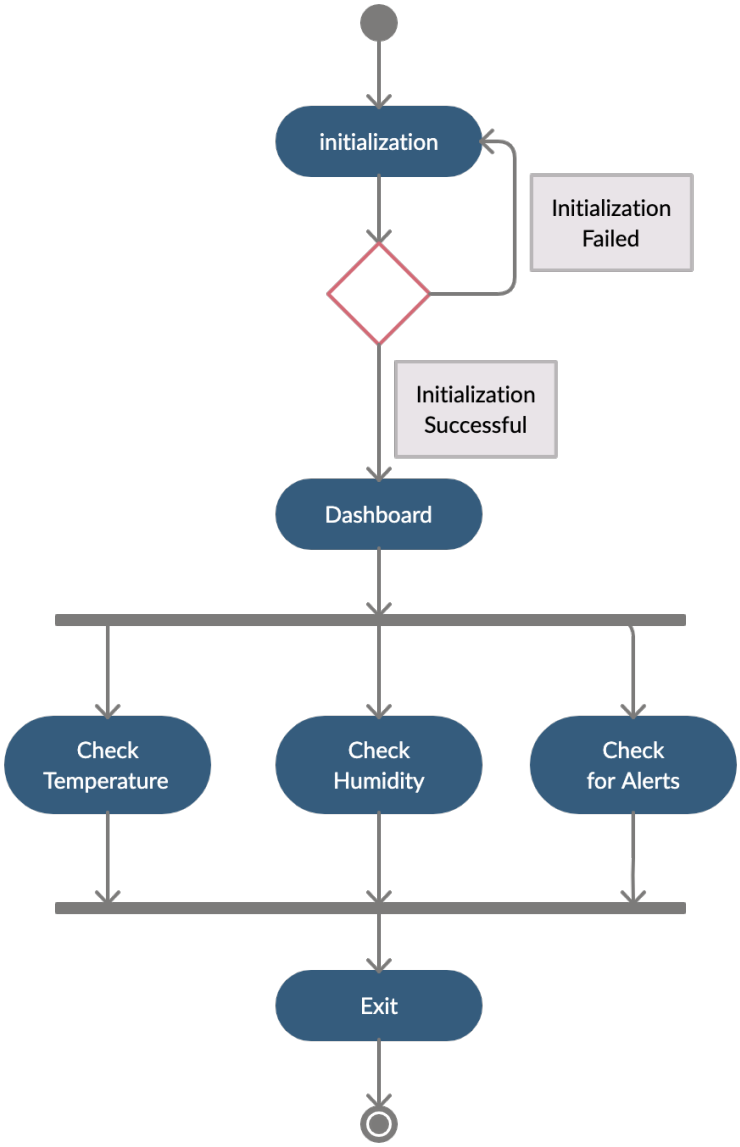
4.2 Class Diagram



4.3 Sequence Diagram



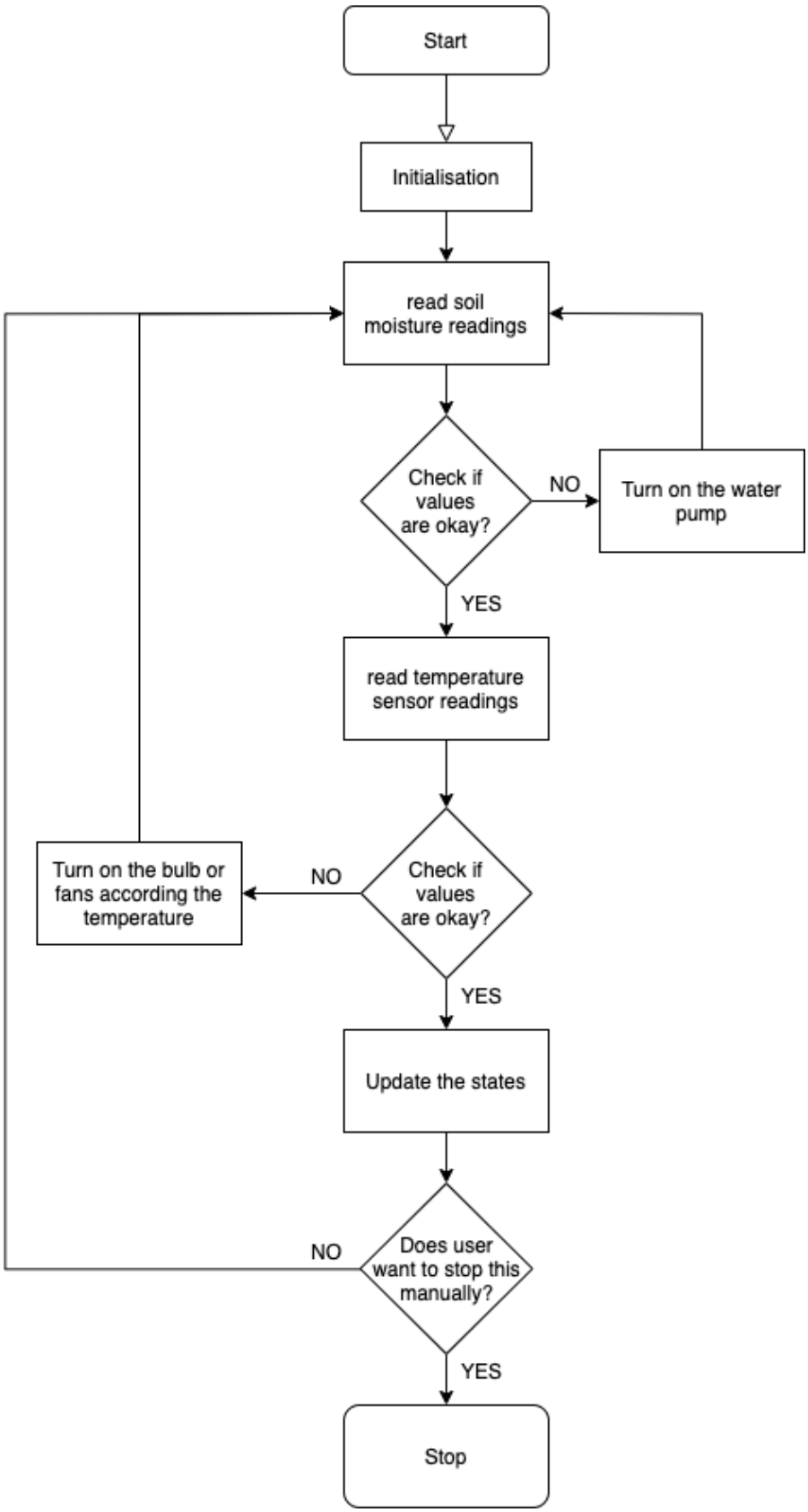
4.4 Activity Diagram



4.5 Data Dictionary

Field Name	Data type	Size	Description
Temperature	Integer	4 bytes	For temperature
Humidity	Integer	4 bytes	For humidity
Moisture	Integer	4 bytes	For soil moisture
Alert	Boolean	-	For alert toggle

4.6 Algorithm Flow



Chapter 5

Canvas

5.1 Empathy Mapping Canvas

Design For Smart Greenhouse **Design By** 97147

Date 18/10/2020 **Version** 1.0

USER	STAKEHOLDERS
Farmers laboratory The Masses (Common people)	Students Government Automation Project Project Investors Leads

ACTIVITIES

Alert in undesired situation

Water management

States management

Temperature management

STORY BOARDING

HAPPY

There was undesirable weather outside, but because of the smart greenhouse, Temperature was in control.

HAPPY

Once there was an unplanned event But because of the smart greenhouse, a farmer did attend that event without worrying.

SAD

Riya was spending so much time and money on manual labor work for optimal growth of plants because the greenhouse needed constant care.

SAD

Riya recently moved to Bombay, and she was very unhappy about the quality of vegetables.

5.2 AEIOU Canvas

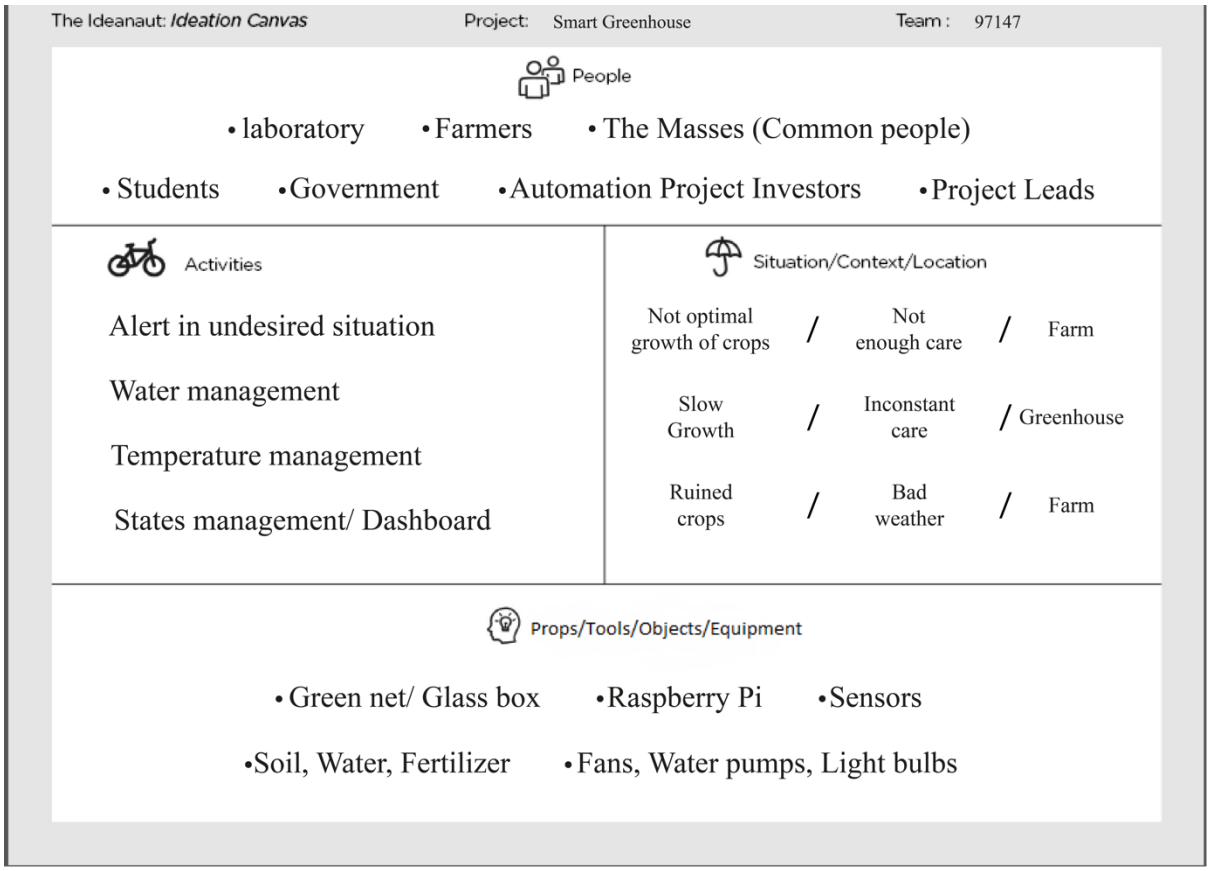
AEIOU Summary:

Group ID: 97147
Domain Name: Smart Greenhouse
Date: 18/10/2020 Version: 1.0

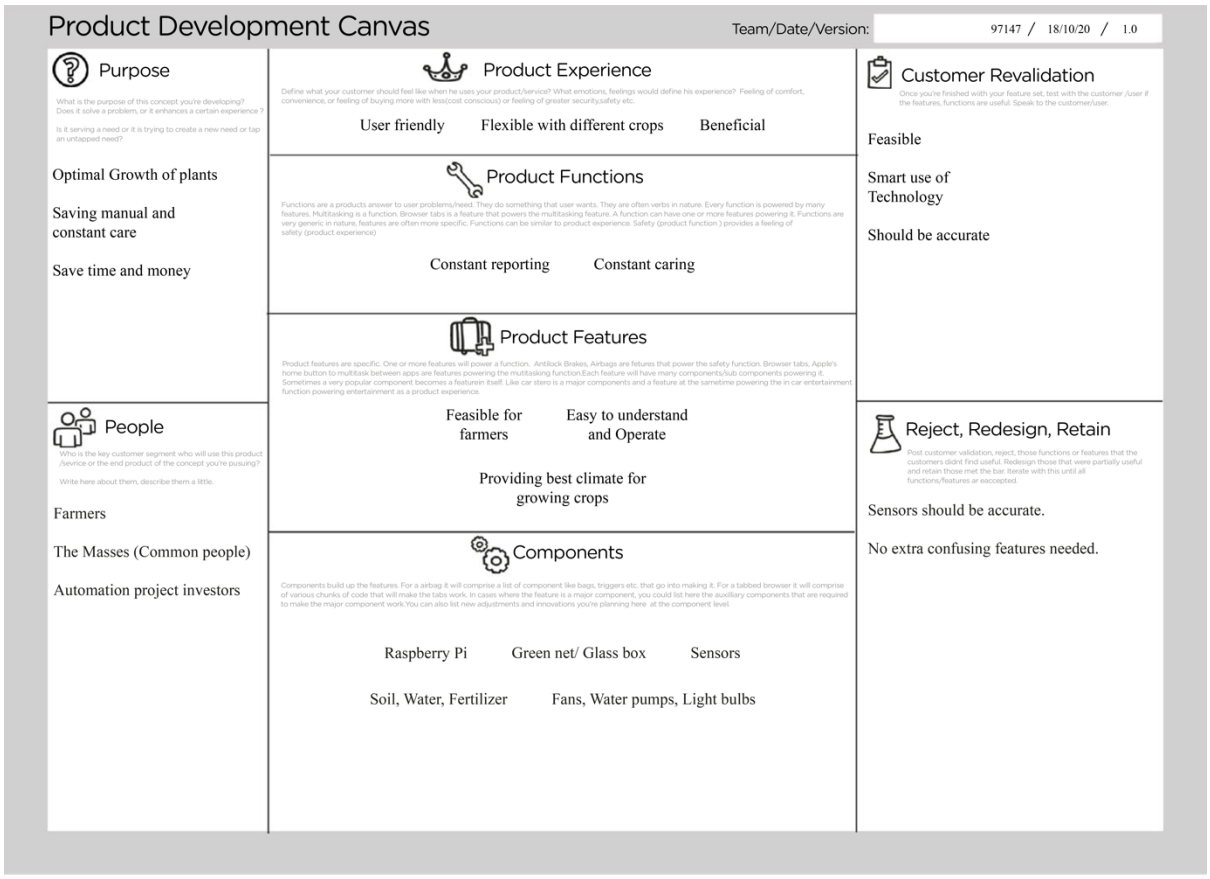
Environment:	Interactions:	Objects:
Greenhouse	Interaction on field/ Interaction with farmers	Green net/ Glass box
Farm	Government's interaction with farmers	Raspberry Pi
Terrace	Interaction with developers.	Temperature sensor
Garden		Moisture sensor
Labs		Fans, Water pumps, Light bulbs

Activities:	Users:
Alert in undesired situation	Farmers
Water management	The Masses (Common people)
Temperature management	laboratory
States management/ Dashboard	

5.3 Ideation Canvas



5.4 Product Development Canvas



Chapter 6
Development

6.1 Coding Standards

Raspberry pi programming can be written in Scratch, Python, Sonic Pi, etc. programming language.

Scratch is a visual programming tool which allows the user to create animations and games with a drag-and-drop interface.

Python is a wonderful and powerful programming language that's easy to use (easy to read and write) and, with Raspberry Pi, lets you connect your project to the real world.

Sonic Pi is an open-source programming environment, designed for creating new sounds with code in a live coding environment; it was developed by Dr Sam Aaron at the University of Cambridge.

6.2 User Interface

We will provide simple GUI with which you can see the temperature and moisture. Also, it can provide history stats.

In, future enhancement we are thinking that we should add more control over sensors which can be controlled through web app.

Chapter 7

Future Enhancements

- We can add more control over sensors and controllers via web app.
- We can make REST API and add app support.
- We can Make it more secure to operate using device. We can put authentication.
- We can use some Bluetooth related features instead of Wi-Fi.
- We can make Admin system/ master-slave system for more control.

Chapter 8

Plagiarism Report

Total Words: 1,799

Total Characters: 9,654

Date: 20th October 2020

Result for first 963 words:

Result for another 836 words:

Content checked for Plagiarism

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1.1 Introduction
1.2 Existing system
1.3 Need for the new system
1.4 Objective of the new system
1.5 Problem definition
1.6 Software process model
1.7 Core components
1.8 Project profile
1.9 Advantages and limitations of existing system
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- India is an agrarian country with around 70% of its people depending directly or indirectly upon agriculture.
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- We can make Admin system/ master-slave system for more control.

Matches:

Sources	Similarity
Farmers' Suicides in India - Reasons and Responses india is an agrarian country with around 70% of its people depending directly or indirectly upon agriculture.in this article, we are analysing the farmers' suicides in india and its related data, the reasons and the way forward. farmers' suicides – what do the facts say? https://www.clearias.com/farmers-suicides/	9%
After 3-Year Delay, Government Releases Farmer Suicide Data this translates into 948 suicides every month, or 31 suicides every day.that final report of accidental deaths and suicides in india has now been released. it was last released in 2015. the number of farmer suicides has shown a decline as per government data, coming down to 11,379 in... https://thewire.in/agriculture/farmer-suicides-data	9%
IoT Based Greenhouse Monitoring System: Technical Review this system realizes the functions of displaying real time data about greenhouse environment factors, data query and setting the warning value.another methodology is stable and reliable to achieve real time monitoring of greenhouse environment. a system architecture is shown in below... https://www.irjet.net/archives/V4/i10/IRJET-V4I10343.pdf	10%
IoT based monitoring and control system for home automation The user here will move directly with the system through a web-based interface over the web, whereas home appliances like lights, fan and door lock are remotely controlled through easy website. An extra feature that enhances the facet of protection from fireplace accidents is its... https://ieeexplore.ieee.org/document/7342646	5%
US8643495B2 - Internet of things based farm greenhouse monitor... a farm greenhouse monitor and alarm management system based on the internet of things with real-time monitoring environmental parameters, which is aimed at monitoring and managing the growth of crops in the farm greenhouse, includes mobile inspection devices, data acquisition units... https://patents.google.com/patent/US8643495B2/en	11%
Smart shopping system [2] rfid-based system gathers data about a certain object without touching it or seeing it stag and forwards the information to a host computer.the main objective of proposed system is to provide a technology oriented, low-cost, easily scalable, and rugged system for assisting shopping in person. https://www.slideshare.net/MahanteshHiremath11/smart-shopping-system-77464373	14%
Under the guidance of: Smt. Lovee Jain Asst. professor Department of... ...resources is not required to maintain the components and collect the raw data from each of the components. reusability: the components areand supports upgradeability. availability: the system is functional throughout and data transfer takes place only when user requests. usability... https://www.scribd.com/presentation/407419385/Smart-Shopping-Cart	3%

Chapter 9
Conclusion

- We have reviewed different formats of smart greenhouse systems. From all, we conclude that farming can be feasible by using smart greenhouse & such systems can be built by using different controllers but it makes the system costly. To overcome this problem we can use the Raspberry Pi to implement a smarter system.
- By using Raspberry Pi, the system becomes less costly. And the coding can be done in Python. Because of python the code is and easy to understand.

Chapter 10

References

https://behrtech.com/blog/4-benefits-of-smart-greenhouses-and-how-to-get-started/

https://www.hackster.io/synergy-flynn-9ffb33/smart-greenhouse-the-future-of-agriculture-5d0e68

https://www.researchgate.net/publication/316448621_IoT_based_smart_greenhouse

https://www.irjet.net/archives/V5/i3/IRJET-V5I3533.pdf

https://www.researchgate.net/publication/317338046_IOT_Based_Smart_Greenhouse_Automation_Using_Arduino

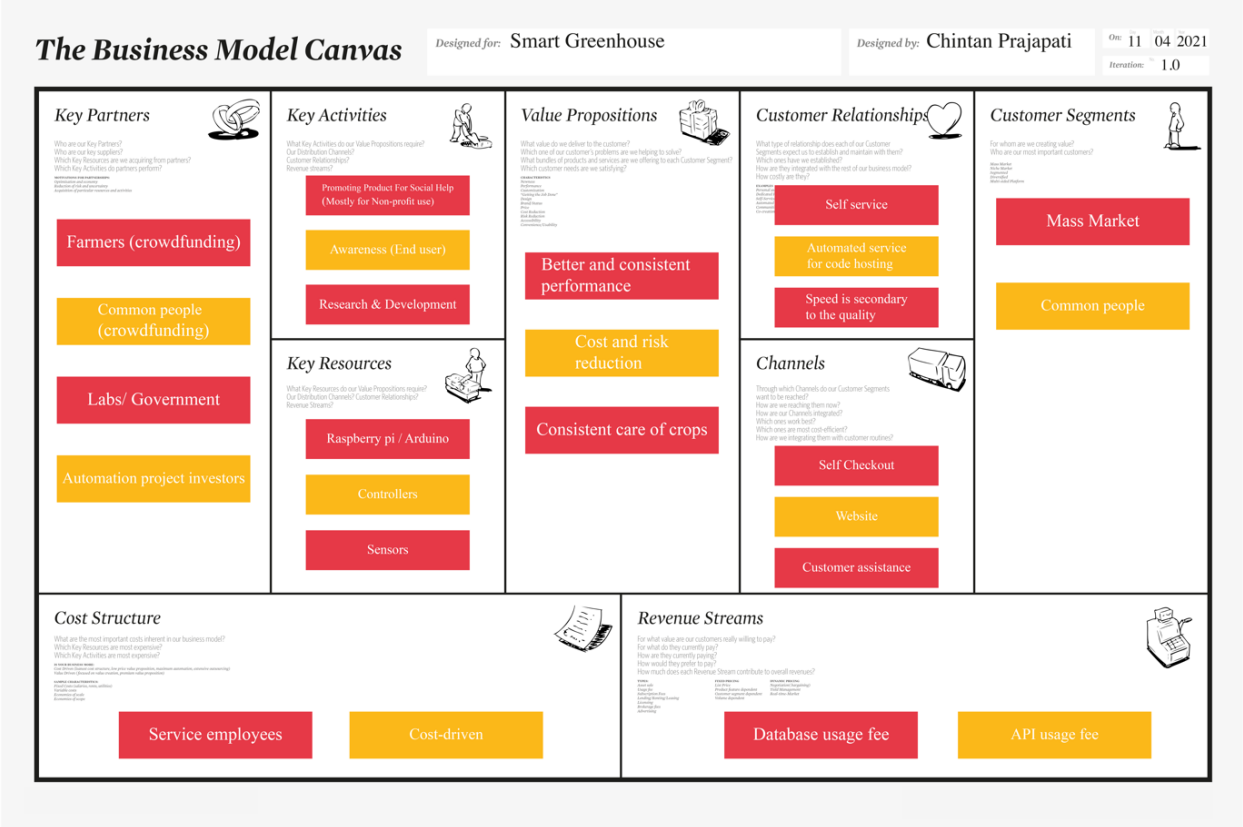
https://www.longdom.org/open-access/intelligent-monitoring-device-for-agricultural-greenhouse-using-iot.pdf

https://www.projectsof8051.com/iot-based-greenhouse-monitoring-and-control-system-project/

https://www.google.com/

Chapter 11

Business Model Canvas (BMC)



11.1 Key Partner

- Farmers (crowdfunding)
- Common people (crowdfunding)
- Labs/ Government
- Automation project investors

11.2 Key Activities

- Promoting Product For Social Help (Mostly for Non-profit use)
- Awareness (End-user)
- Research & Development

11.3 Key Resources

- Raspberry pi / Arduino
- Controllers
- Sensors

11.4 Value Propositions

- Better and consistent performance
- Cost and risk reduction
- Consistent care of crops

11.5 Customer Relationships

- Self-service
- Automated service for code hosting
- Speed is secondary to the quality

11.6 Channels

- Self Checkout
- Website
- Customer assistance

11.7 Customer Segments

- Mass Market
- Common people

11.8 Cost Structure

- Cost-driven
- Service employees

11.9 Revenue Stream

- Database usage fee
- API usage fee

Chapter 12

Periodic Progress Report (PPR)

College : SARDAR VALLABHBHAI PATEL INSTITUTE OF TECHNOLOGY, VASAD
StudentName : Prajapati Chintan Dineshbhai
EnrollmentNo : 170410116089 Department : Information Technology
MobileNo : 7048699554 Discipline : BE
Email : chintan.170410116089@gmail.com Semester : Semester 8

PPR Details

Periodic Progess Report : First

PPR

Project : Smart Greenhouse

Status : Submitted

1. What Progress you have made in the Project ?

I have done circuit designing and test on diagram. Also I started with the test on individual elements incircuit.

2. What challenge you have faced ?

No proper documentation for soil moisture sensor, ads1115, L298n was available. So I did my best to pull all the knowledge from the deep web (Using TOR), still some of the things arent specified the waythey should.

3. What support you need ?

I expect we do have an alternative of hardware.

4. Which literature you have referred ?

I have referred some of the web links and Videos. Although I dont have all the links. https://www.electronicshub.org/raspberry-pi-l298n-interface-tutorial-control-dc-motor-l298n- raspberry-pi/ https://learn.adafruit.com/raspberry-pi-analog-to-digital-converters/ads1015-slash-ads1115

Comments

Comment by Internal Guide :
None

Comment by External Guide :
None

Comment by HOD :
None

Comment by Principal :
None

Comment by University Admin :
None

PPR Details

Periodic Progess Report : Second PPR

Project : Smart Greenhouse

Status : Submitted

1. What Progress you have made in the Project ?

I have completed the backend for responsive website using Node.js, Express.js and MongoDB.

2. What challenge you have faced ?

The problem I faced was scalability, when I was trying to build and application on try and error (spiral model) bases I had to go back and revisit my code to make it more convenient.

3. What support you need ?

In this case I do not need any kind of support. As the problems I faced, are now solved.

4. Which literature you have referred ?

I have referred to my old git repos which I created while I was learning MERN stack.

Comments

Comment by Internal Guide :

None

Comment by External Guide :

None

Comment by HOD :

None

Comment by Principal :

None

Comment by University Admin :

None

PPR Details

Periodic Progess Report : Third PPR

Project : Smart Greenhouse

Status : Submitted

1. What Progress you have made in the Project ?

I have made a circuit on board. I tested all the components individually and then combined it all.

2. What challenge you have faced ?

The task was not easy, I did wrote some code. And I was constantly worried so much - because one small error in the code and it can burn my circuit or fuse it. I faced the days when I tried for hours and hours and didnt find any solution for the bug. I took rest and tried again the other day.

3. What support you need ?

As I said an alternative to the hardware would be appreciated. As Raspberry Pi costs so much. And proper documentation by hardware manufacturer also.

4. Which literature you have referred ?

I have referred some of the official Raspberry Pi documentation and some other by adafruit.

Comments

Comment by Internal Guide :

None

Comment by External Guide :

None

Comment by HOD :

None

Comment by Principal :

None

Comment by University Admin :

None

PPR Details

Periodic Progess Report : Forth PPR

Project : Smart Greenhouse

Status : Submitted

1. What Progress you have made in the Project ?

I have finished Implementation of my project, Now I need to write good documentation.

2. What challenge you have faced ?

Hosting a node.js application was not easy. Sometimes it didnt show the pages. Sometimes it didnt resolve the path. These problems are common says the DEVs as this is the starting stage in node.js technology for some of the Hosting websites.

3. What support you need ?

I prefer I get some of the grant/ subsidy approved for individual use of my project by farmers.

4. Which literature you have referred ?

I have referred official documentation by Heroku.com and Node.js also.

Comments

Comment by Internal Guide :

None

Comment by External Guide :

None

Comment by HOD :

None

Comment by Principal :

None

Comment by University Admin :

None

Chapter 13

Patent Drafting Exercise (PDE)

College : SARDAR VALLABHBHAI PATEL INSTITUTE OF TECHNOLOGY, VASAD
Department : Information Technology
Discipline : BE
Semester : Semester 8
Project Name : Smart Greenhouse
Team ID : 129053

Form 1 – APPLICATION FOR GRANT OF PATENT

Applicants :

Sr. No	Name	Nationality	Address	Mobile No.	Email Id
1	Prajapati Chintan Dineshbhai	Indian	Information Technology , SARDAR VALLABHBHAI PATEL INSTITUTE OF TECHNOLOGY, VASAD , Gujarat Technologycal University.	7048699554	chintan.170410116089@gmail.com

Inventors :

Sr. No	Name	Nationality	Address	Mobile No.	Email Id
1	Prajapati Chintan Dineshbhai	Indian	Information Technology , SARDAR VALLABHBHAI PATEL INSTITUTE OF TECHNOLOGY, VASAD , Gujarat Technologycal University.	7048699554	chintan.170410116089@gmail.com

I/We, the applicant(s) hereby declare(s) that:

Following are the attachments with the applications :

Form 2 - PROVISIONAL/COMPLETE SPECIFICATION

1 . Title of the project/invention :
Smart Greenhouse
2. Preamble to the description :
Provisional
3. Description
a) Field of Project / Invention / Application :

Internet of things, Automation, Raspberry pi 4/ Arduino, Greenhouse, Agriculture

b) Prior Art / Background of the Project / Invention :

This IoT based smart greenhouse system enables data such as soil moisture and temperature to be collected in real-time and automatically decide whether to water batches of crops, turn on the fan/ bulb.

c) Summary of the Project / Invention :

We can preserve a certain humidity and temperature range for optimal plant growth in Smart Greenhouse. Within a few seconds, the sensors will detect changes and report to the custodian. This project would facilitate the cultivation of greenhouse plants. This can be done by using an intelligent greenhouse. It can also reassure you that plants are cared for during holidays or during a longer time around the greenhouse.

d) Objects of Project / Invention :

India is an agrarian country that relies directly or indirectly on agriculture for about 70 percent of its population. The aim is to bring the benefits of Smart Greenhouse to all farmers and all citizens.
Unfortunately, According to The Wire, in 2016 - 11,379 farmers in India died from suicide. Each month, that results in 948 suicides, or 31 each day.
The aim is to try to prevent suicide. We are partnering in this transformation with the government and communities.

e) Drawings :

129053_Drawing1.png
129053_Drawing2.png

f) Description of Project / Invention : (full detail of project) :

At greenhouse temperatures, high humidity can produce transpiration, water vapor condensation on various surfaces of the greenhouse, and wetland evaporation. Such challenges can be solved. It can also reassure you that plants are cared for during holidays or during a longer time around the greenhouse.

g) Examples :

h) Claims (Not required for Provisional Application) / Unique Features of Project

Claim 1: A smart greenhouse system based on the Internet of things comprising:
a device for receiving data/ monitoring (Laptop/ Phone - Web Browser), Temperature and Moisture reading modules (Sensors), storage unit (Mongo DB), data processing units (REST API), data communicating modules (WiFi Router/ LAN), I/O modules, power supply, and IoT devices in the greenhouse to identify a unique greenhouse and get data of temperature and moisture parameters through wireless networks, with the data of temperature and moisture parameters saved to judge whether to alarm or wether to water a batch or turn on fan/ bulb.
Claim 2: The smart greenhouse system of claim 1, whereby the smart greenhouse system involves wireless communication between the data collection unit and the data receiving devices in the greenhouse.
Claim3: The smart greenhouse system as claimed in claim 1, wherein the data collecting unit includes temperature and moisture sensors.
Claim 4: To be precise the smart greenhouse system consists of:
I) Raspberry pi 4
II) DHT11 and Soil moisture sensor
III) ADS1115 (analog to digital converter)
IV) Bulb, NPN transistor, and External battery
V) LN293N motor driver
VI) Water pump, Fan, and External battery

4. Claims

5. Date and signature

6. Abstract of the project / invention :

At greenhouse temperatures, high humidity can produce transpiration, vapor condensation on various surfaces of the greenhouse, and wetland evaporation. Such challenges can be solved. It can also reassure you that plants are cared for during holidays or during a longer time around the greenhouse.

Form 3 – STATEMENT AND UNDERTAKING UNDER SECTION 8

Name of the applicant(s) :

I/We, Prajapati Chintan Dineshbhai

Hereby declare :

Name,Address and Nationality of the joint applicant :

(i) that I/We have not made any application for the same/substantially the same victim invention outside India.

(ii) that the rights in the application(s) has/have been assigned to

Name of the Country	Date of Application	Application Number	Status of the Application	Date of Publication	Date of Grant
N/A	N/A	N/A	N/A	N/A	N/A

(iii)That I/We undertake that upto the date of grant of the patent by the Controller, I/We would keep him informed in writing the details regarding corresponding applications for patents filed outside India within three months from the date of filing of such application.

Dated this 17 day of April 2021

To be signed by the applicant or his authorised registered patent agent :

Signature.....

Name of the Natural Person who has signed :

Prajapati Chintan Dineshbhai

To,
The Controller of Patents,
The Patent Office,
At Mumbai