Sheffield Hallam University

2018

MARS EXPLORATION - ADBCSA Assignment (Group)

Name	SLIIT ID	SHU ID
Perera P.A.H.E.	IT16083424	27045240
W.M.I.O. Wijesinghe	IT16051294	27045261
M.B. Wijesinghe	IT16043688	27045260
W.M. Ruwan Wijesinghe	IT16077348	27045263

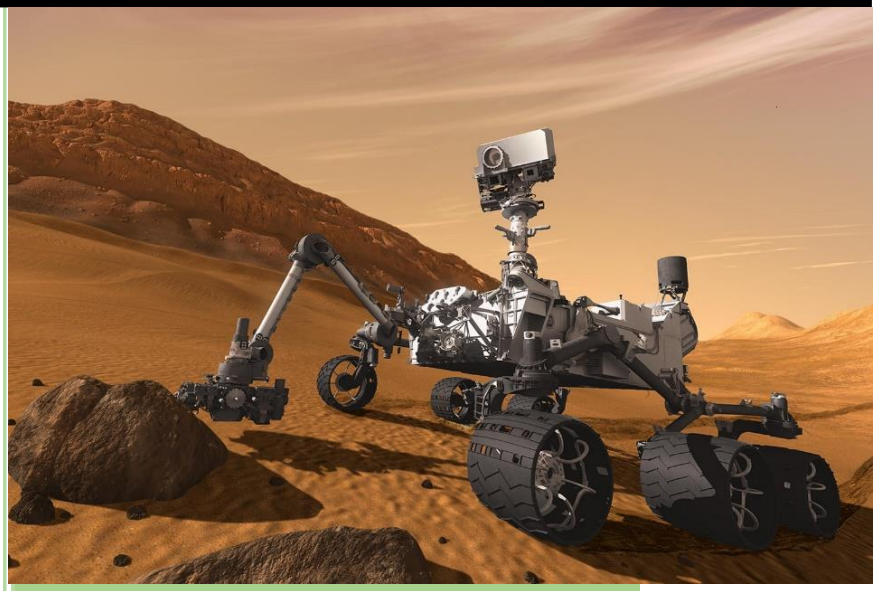


Table of Contents

1. Introduction

Curiosity and Opportunity are rovers designed by NASA to explore the surface of the planet Mars. The aim of this document is to provide a detailed description of the database system we propose a rover-based Mars exploration system.

Our proposed system consists of three roles. It can perform the roles of a creator(scientist), an explorer and a developer.

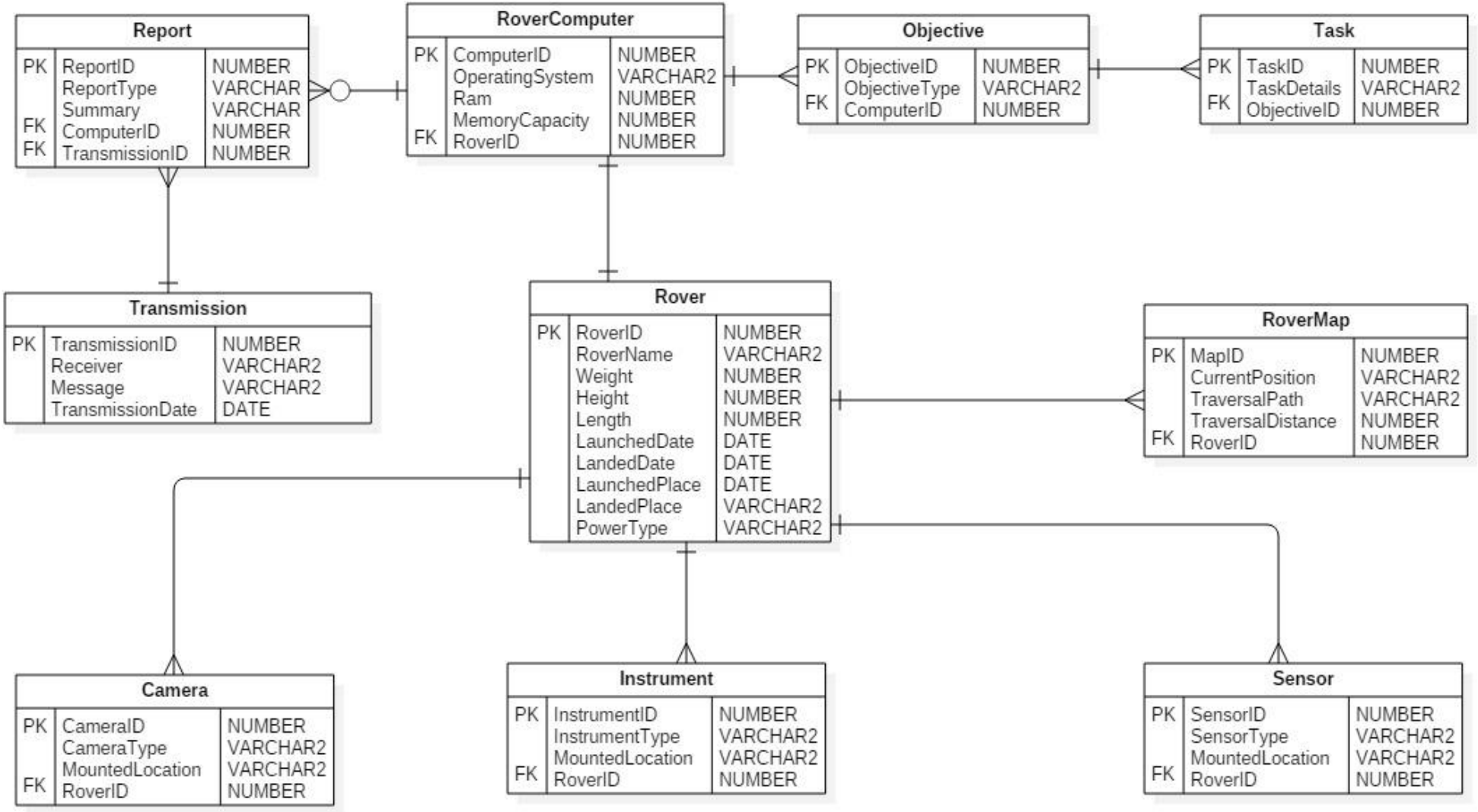
First, as a creator, the system can add rover attributes such as Rover ID, Rover Name, launched date, etc. This facilitates the adding of not only the rovers Curiosity and Opportunity, but also any number of new rovers to the system. These rovers can be updated at any time. Secondly, it can add a Brain to the rover which is the rover computer. It consists of an operating system, RAM, memory capacity, etc. Next, the system can add Eyes to the rover permitting it to identify and explore the Martian surface and find its path. This is done through several types of cameras fixed to the rover. Then the system is capable of adding instruments like wheels, arms and telecommunication equipment to the rover. Further, adding sensors can also be done by the system. These sensors will allow the rover to monitor the Martian environment.

Next, as an explorer, the system can add objectives to the created rover. Objectives can be biological, geological and geochemical, planetary process, etc. Then it can add tasks for those created objectives. Tasks can be activities like determining the nature and inventory of organic carbon compounds, interpreting the processes that have formed and modified rocks and soils, etc. Then, the system adds pre-identified way-points, and then add elements discovered between selected waypoints. It can calculate the total distance travelled by a rover and other necessary calculations. Finally, as an explorer, the system generates a report containing all the information gathered and if required, sends it to the Earth.

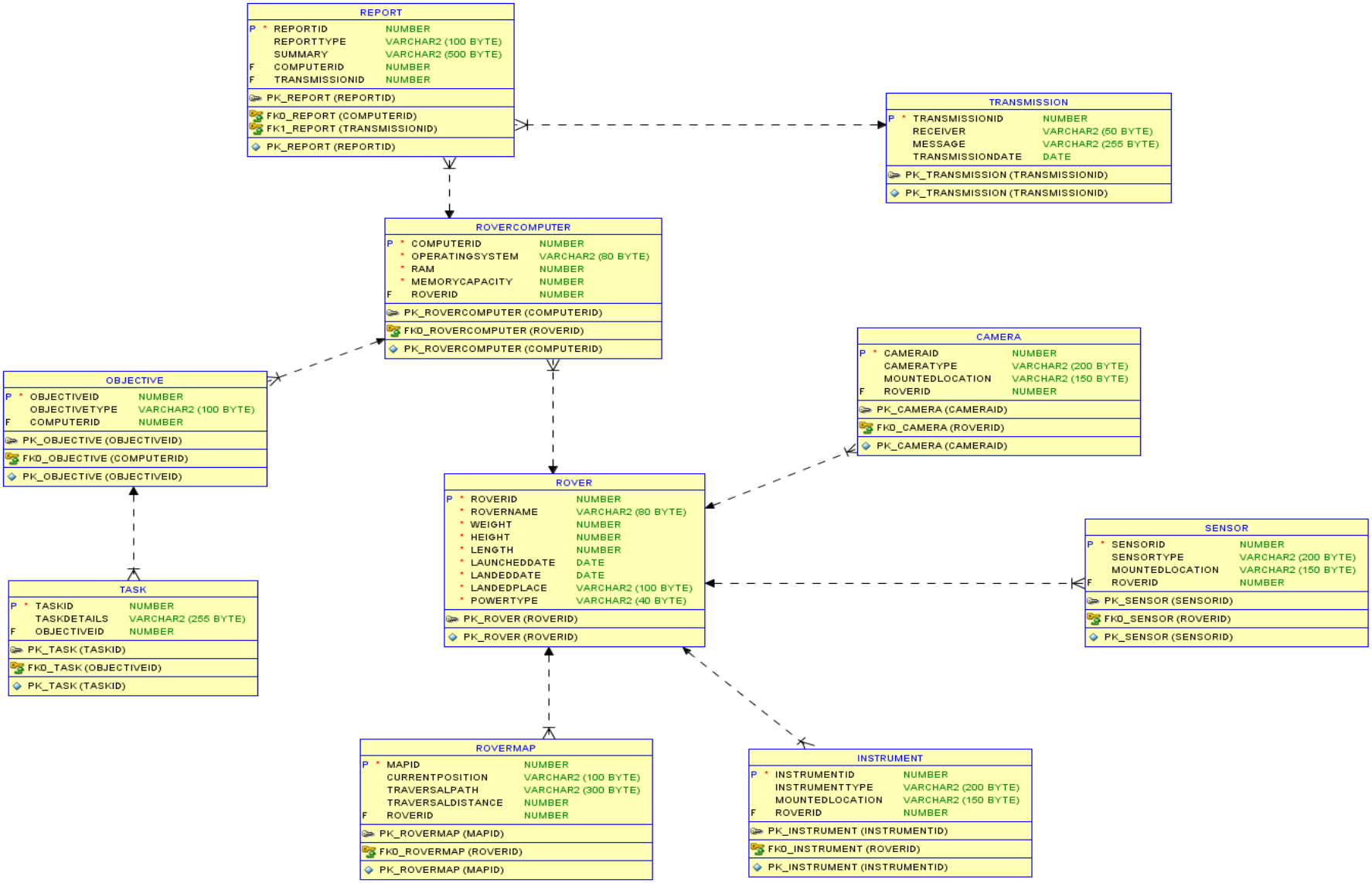
Then, as a developer, the system can add operating systems, sensors, cameras and instruments that are to be added to rovers. The system can also create objectives for Rovers to follow. These additions are used by the other two roles.

With four members individually having unique ER diagrams for the same system, due to difficulties in implementation, the following ER was created as the sole ER Diagram for the system.

2. ER diagram


Report
PK ReportID NUMBER
ReportType VARCHAR
Summary VARCHAR
FK ComputerID NUMBER
FK TransmissionID NUMBER
RoverComputer
PK ComputerID NUMBER
OperatingSystem VARCHAR2
Ram NUMBER
MemoryCapacity NUMBER
FK RoverID NUMBER
Objective
PK ObjectiveID NUMBER
ObjectiveType VARCHAR2
FK ComputerID NUMBER
Task
PK TaskID NUMBER
TaskDetails VARCHAR2
FK ObjectiveID NUMBER
Transmission
PK TransmissionID NUMBER
Receiver VARCHAR2
Message VARCHAR2
TransmissionDate DATE
Rover
PK RoverID NUMBER
RoverName VARCHAR2
Weight NUMBER
Height NUMBER
Length NUMBER
LaunchedDate DATE
LandedDate DATE
LaunchedPlace DATE
LandedPlace VARCHAR2
PowerType VARCHAR2
RoverMap
PK MapID NUMBER
CurrentPosition VARCHAR2
TraversalPath VARCHAR2
TraversalDistance NUMBER
FK RoverID NUMBER
Camera
PK CameraID NUMBER
CameraType VARCHAR2
MountedLocation VARCHAR2
FK RoverID NUMBER
Instrument
PK InstrumentID NUMBER
InstrumentType VARCHAR2
MountedLocation VARCHAR2
FK RoverID NUMBER
Sensor
PK SensorID NUMBER
SensorType VARCHAR2
MountedLocation VARCHAR2
FK RoverID NUMBER

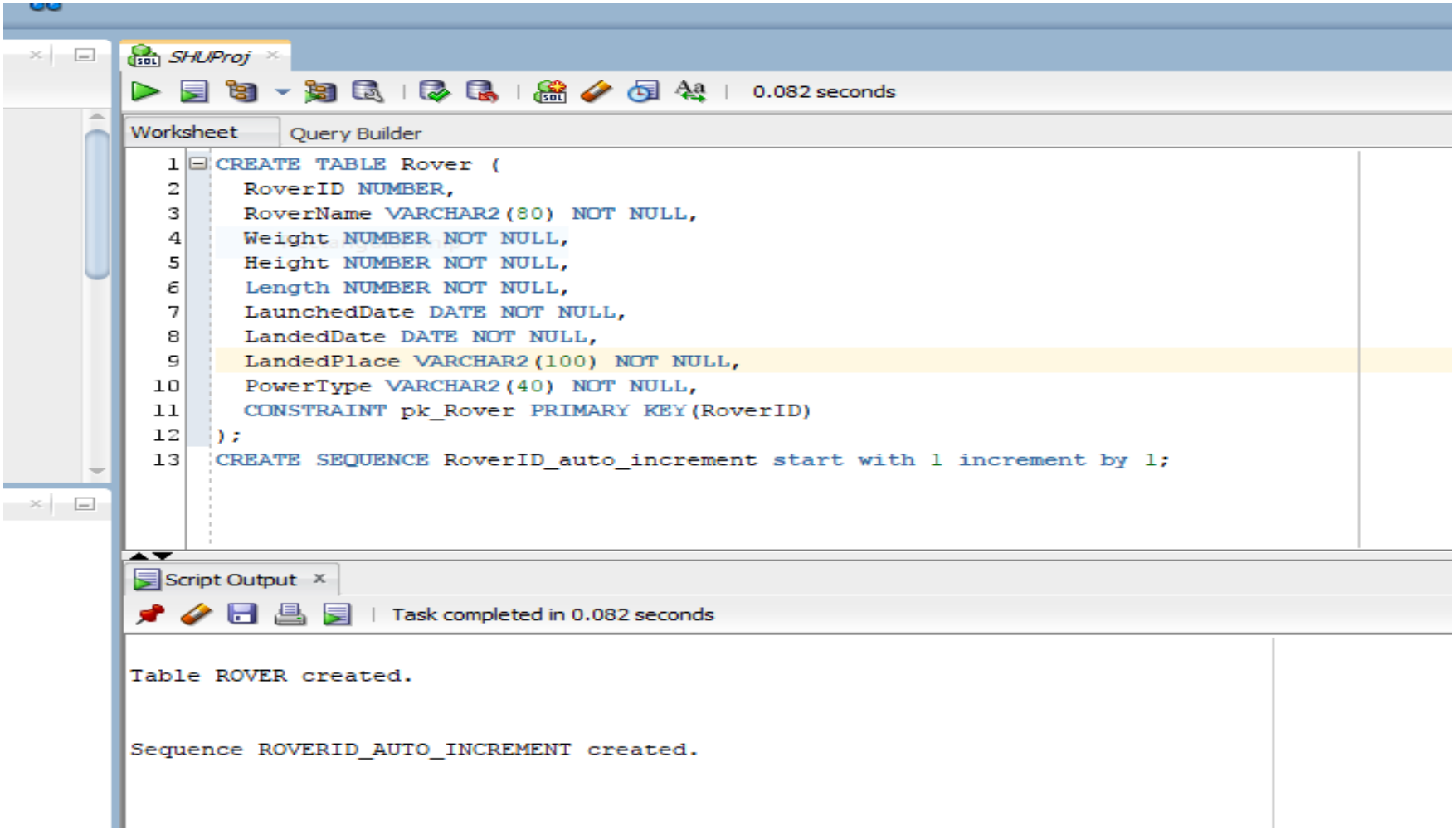
3. Relational Model



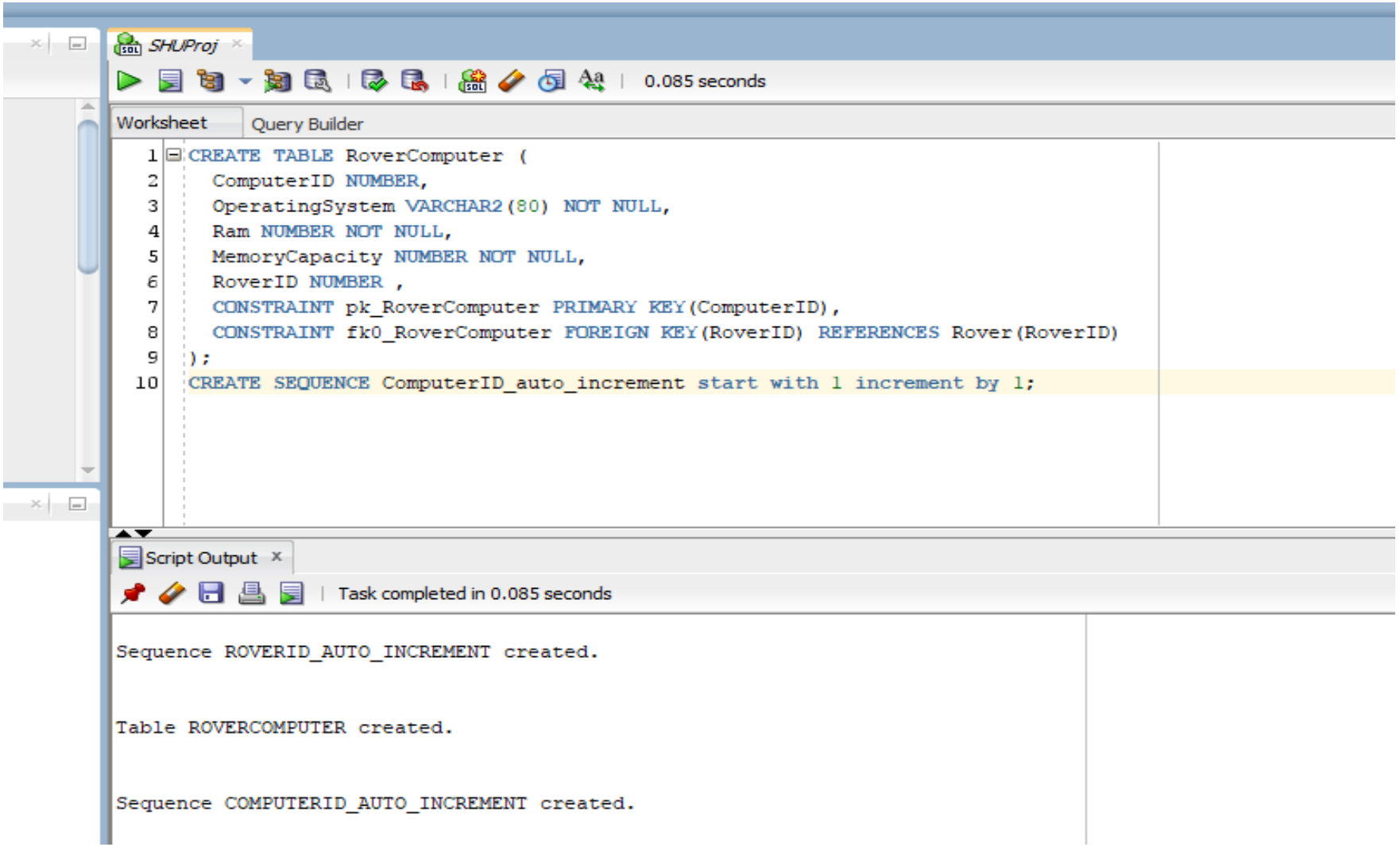
4. Database Implementation

Database Table

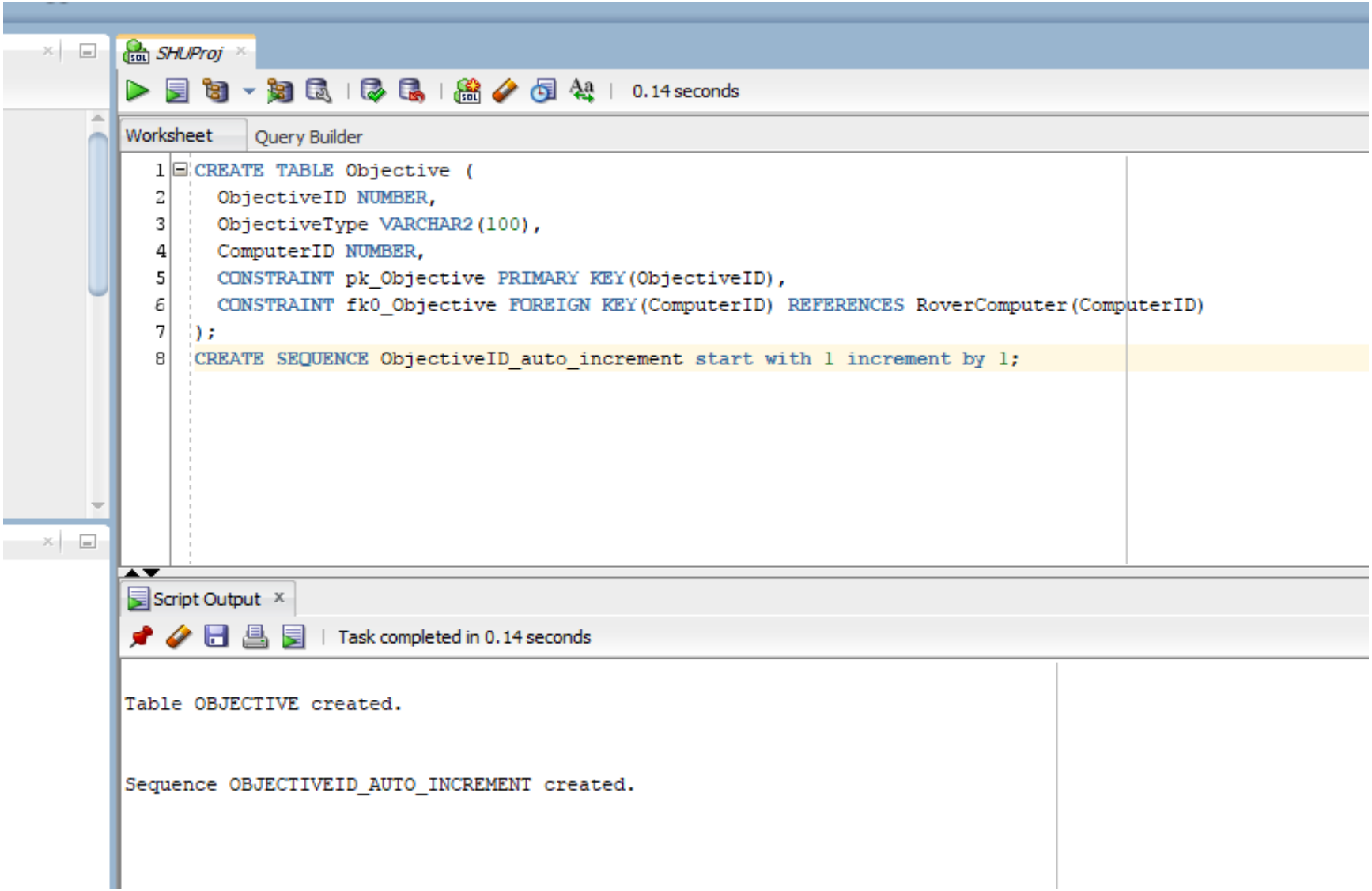
Rover Table



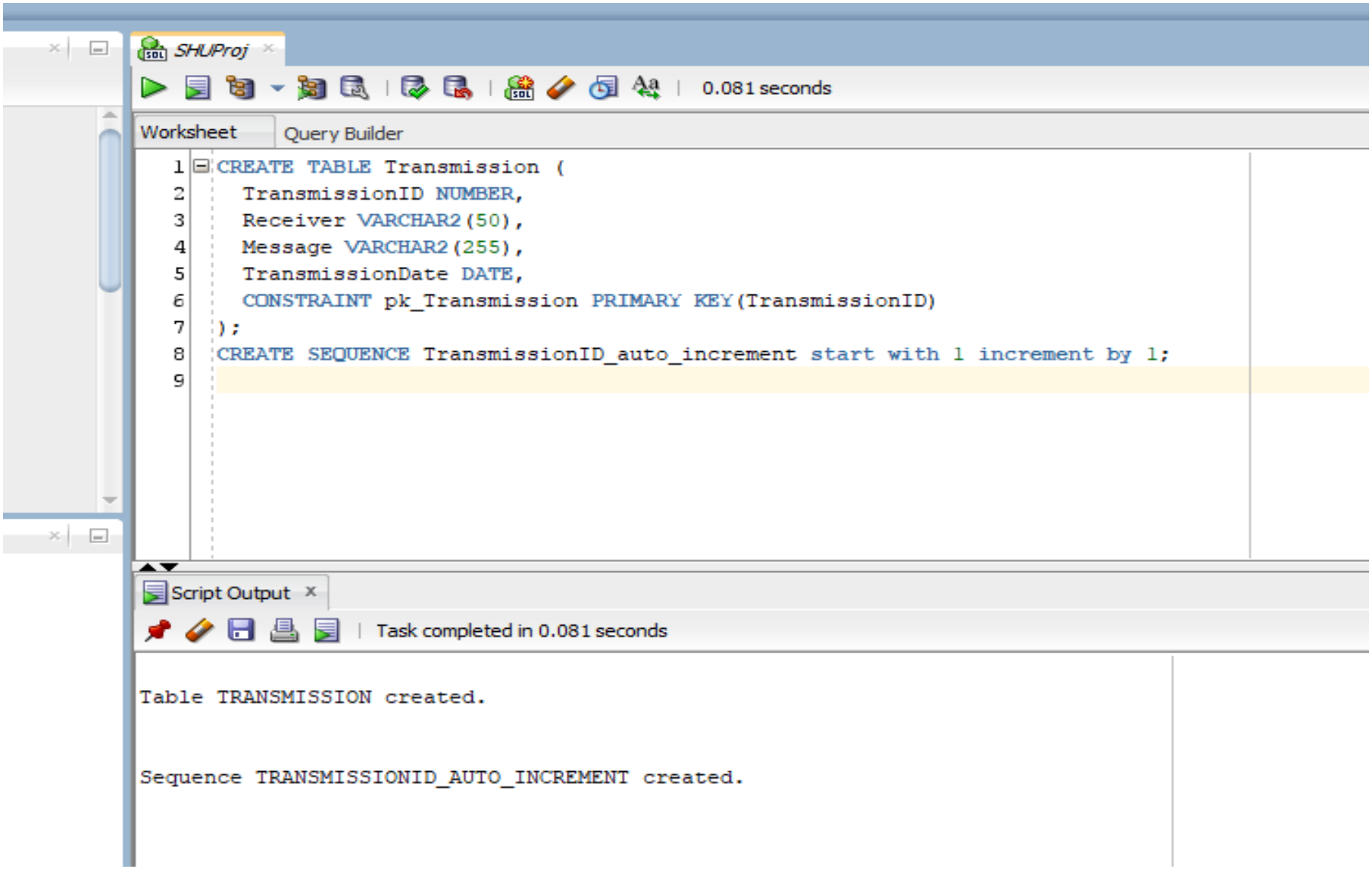
RoverComputer Table



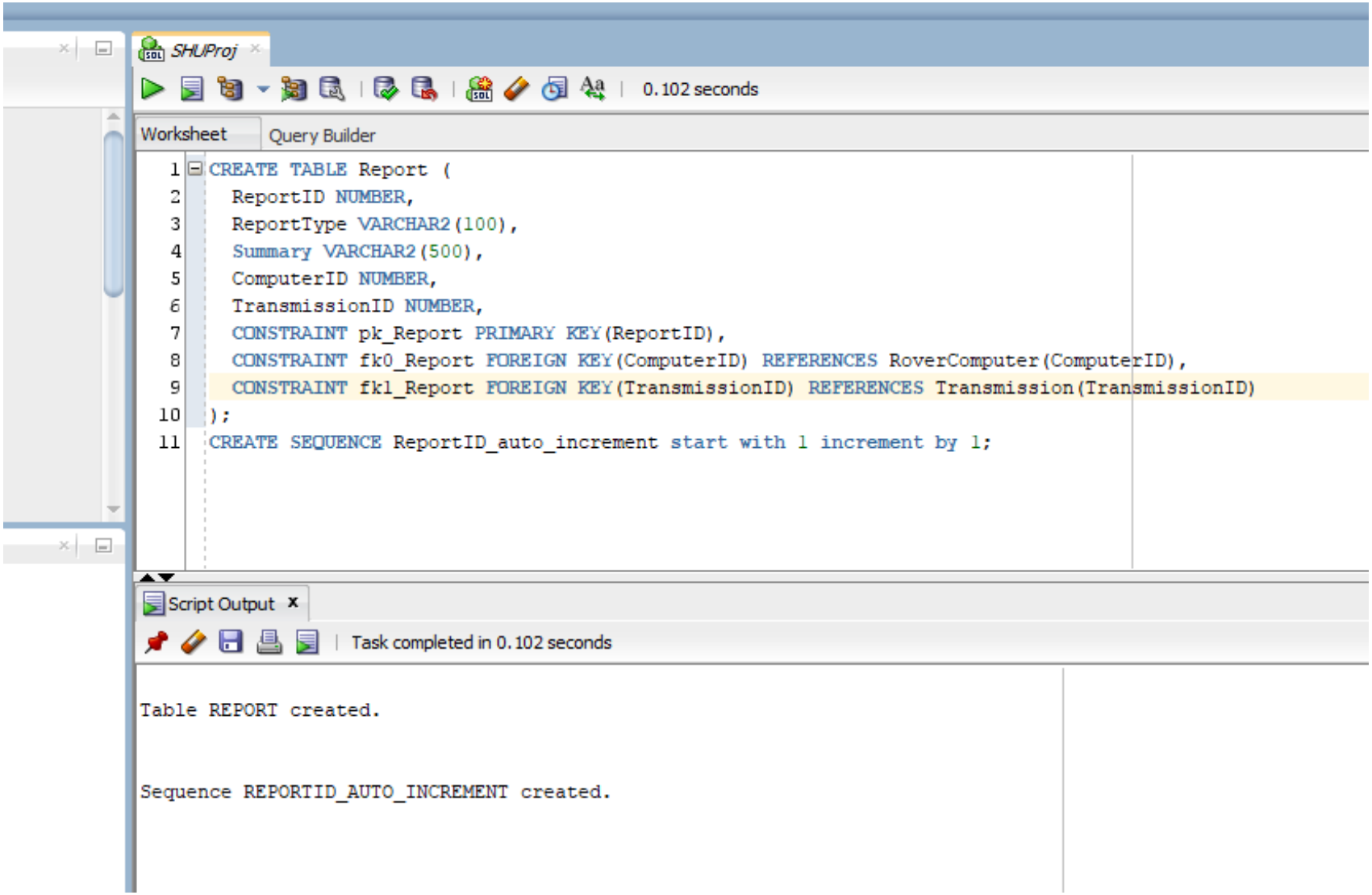
Objective Table



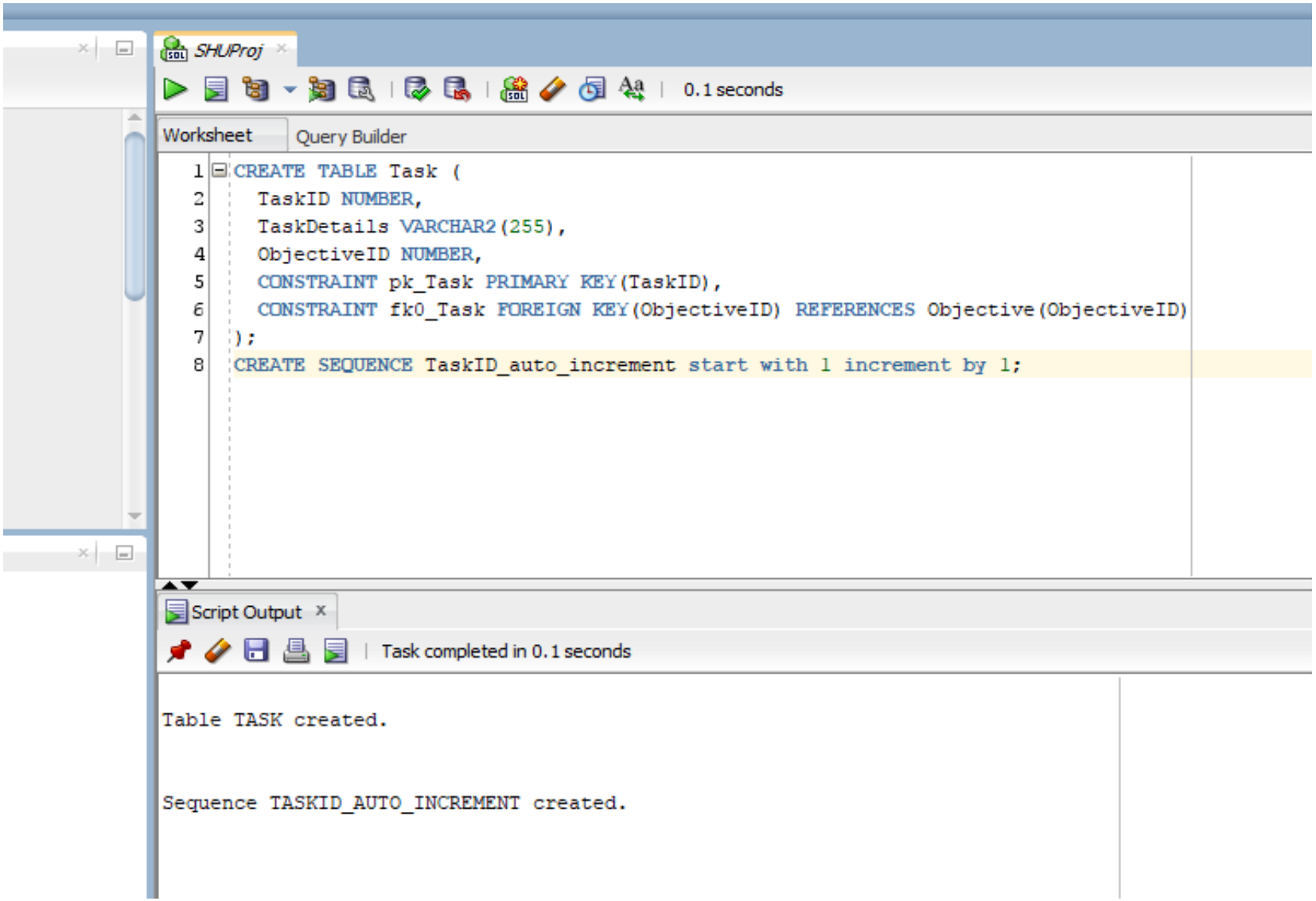
Transmission Table



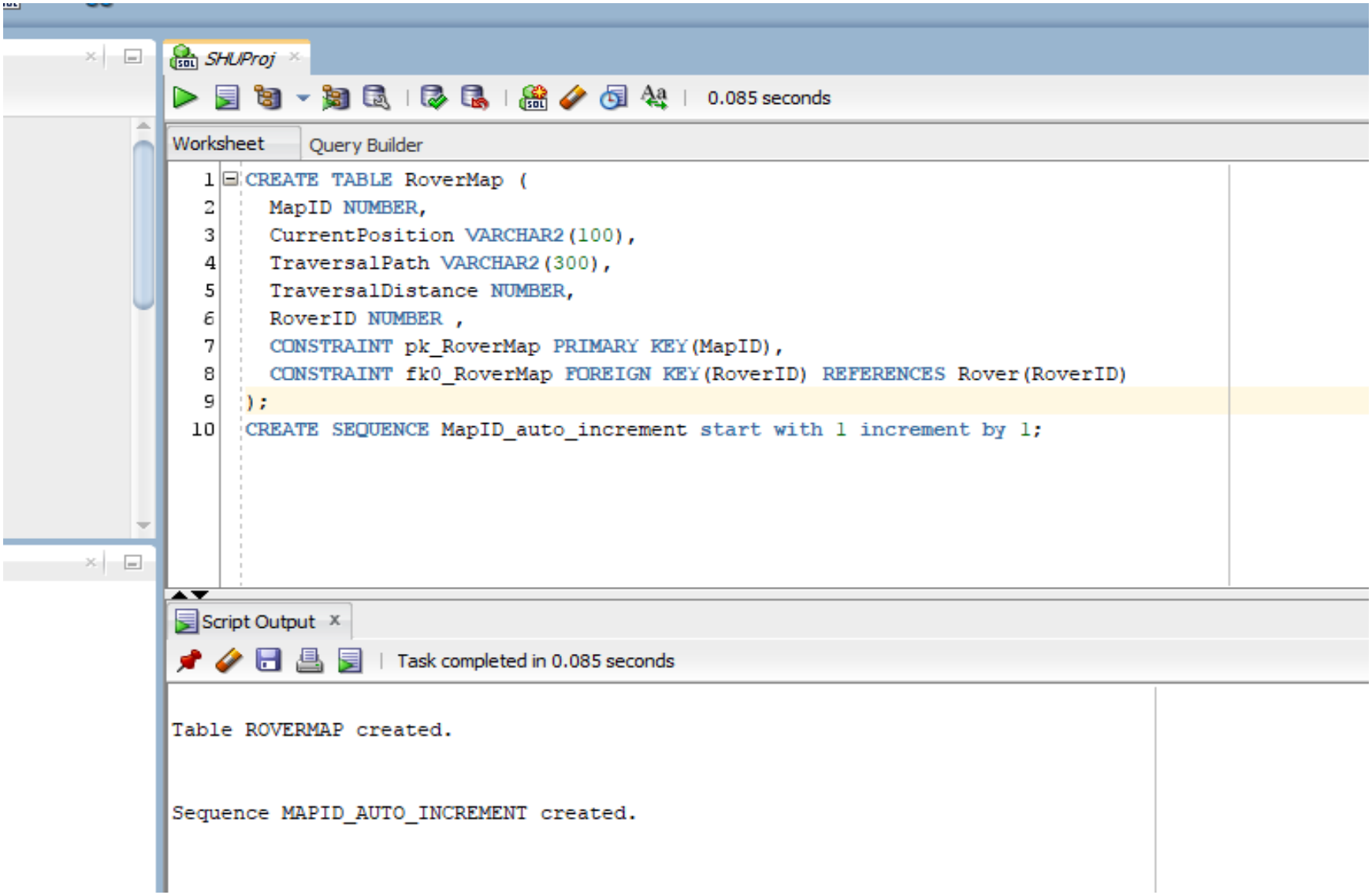
Report Table



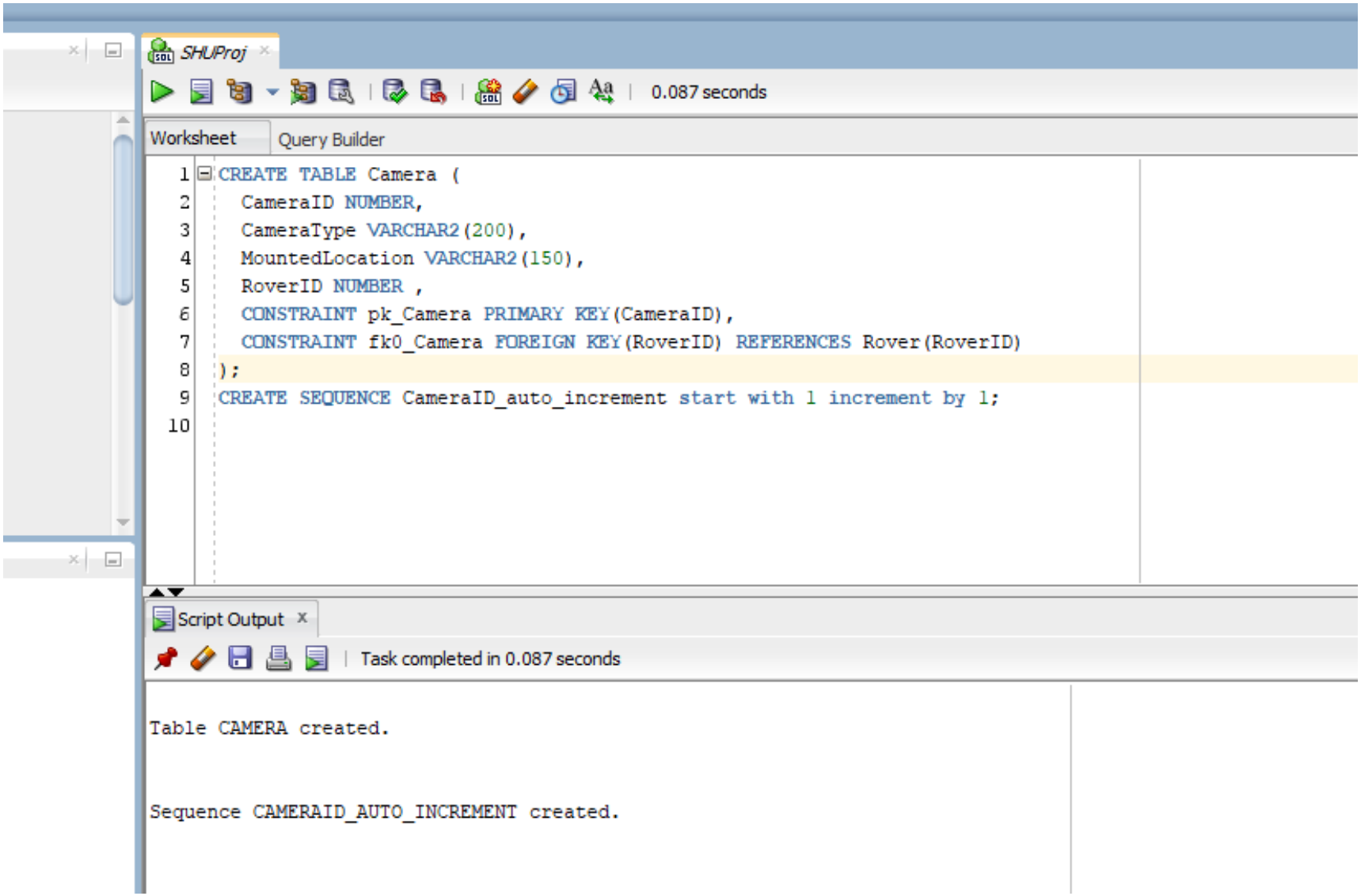
Task Table


SHUProj
0.1 seconds
Worksheet
Query Builder
1 CREATE TABLE Task (
2 TaskID NUMBER,
3 TaskDetails VARCHAR2(255),
4 ObjectiveID NUMBER,
5 CONSTRAINT pk_Task PRIMARY KEY(TaskID),
6 CONSTRAINT fk0_Task FOREIGN KEY(ObjectiveID) REFERENCES Objective(ObjectiveID)
7);
8 CREATE SEQUENCE TaskID_auto_increment start with 1 increment by 1;
Script Output
Task completed in 0.1 seconds
Table TASK created.
Sequence TASKID_AUTO_INCREMENT created.

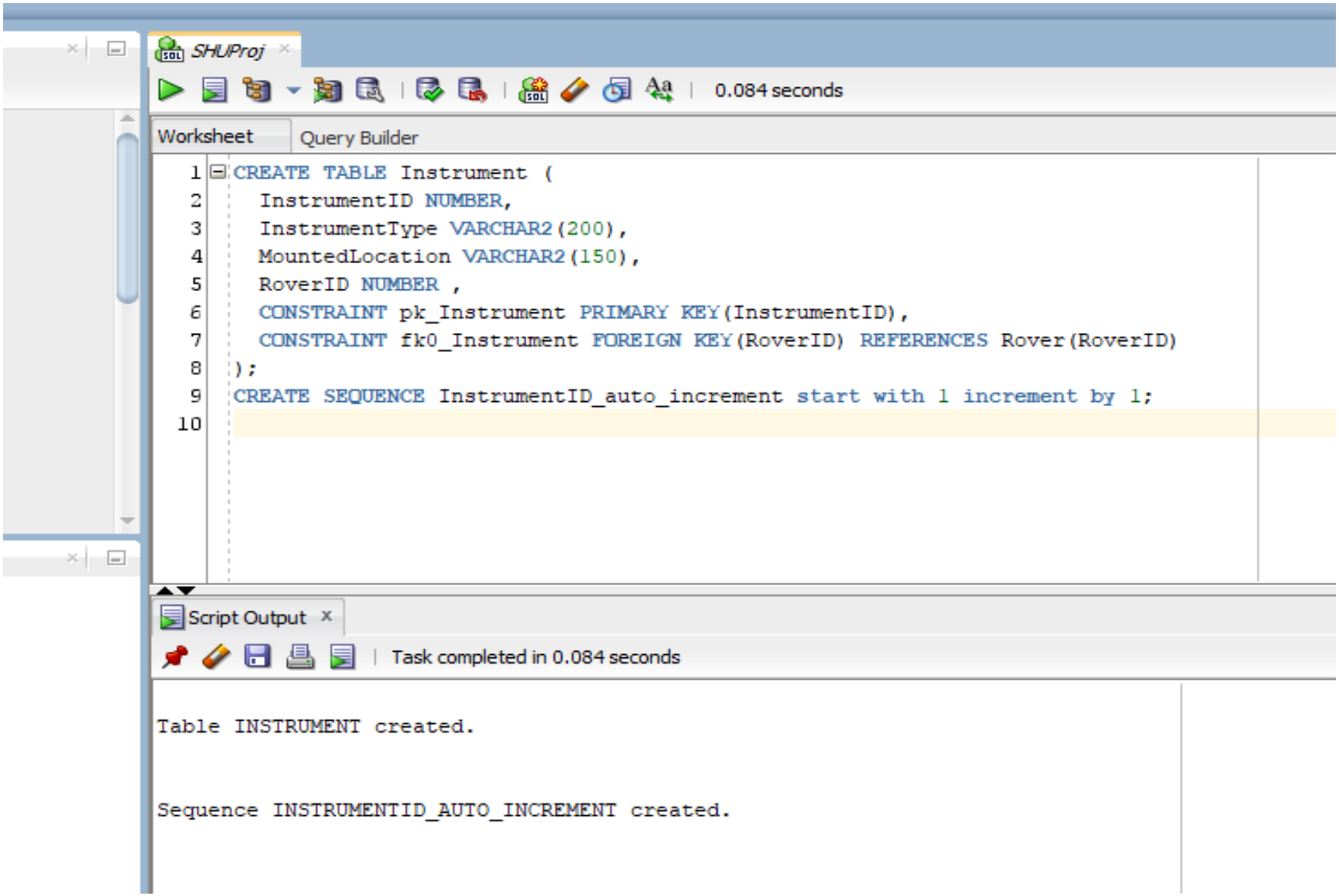
RoverMap Table



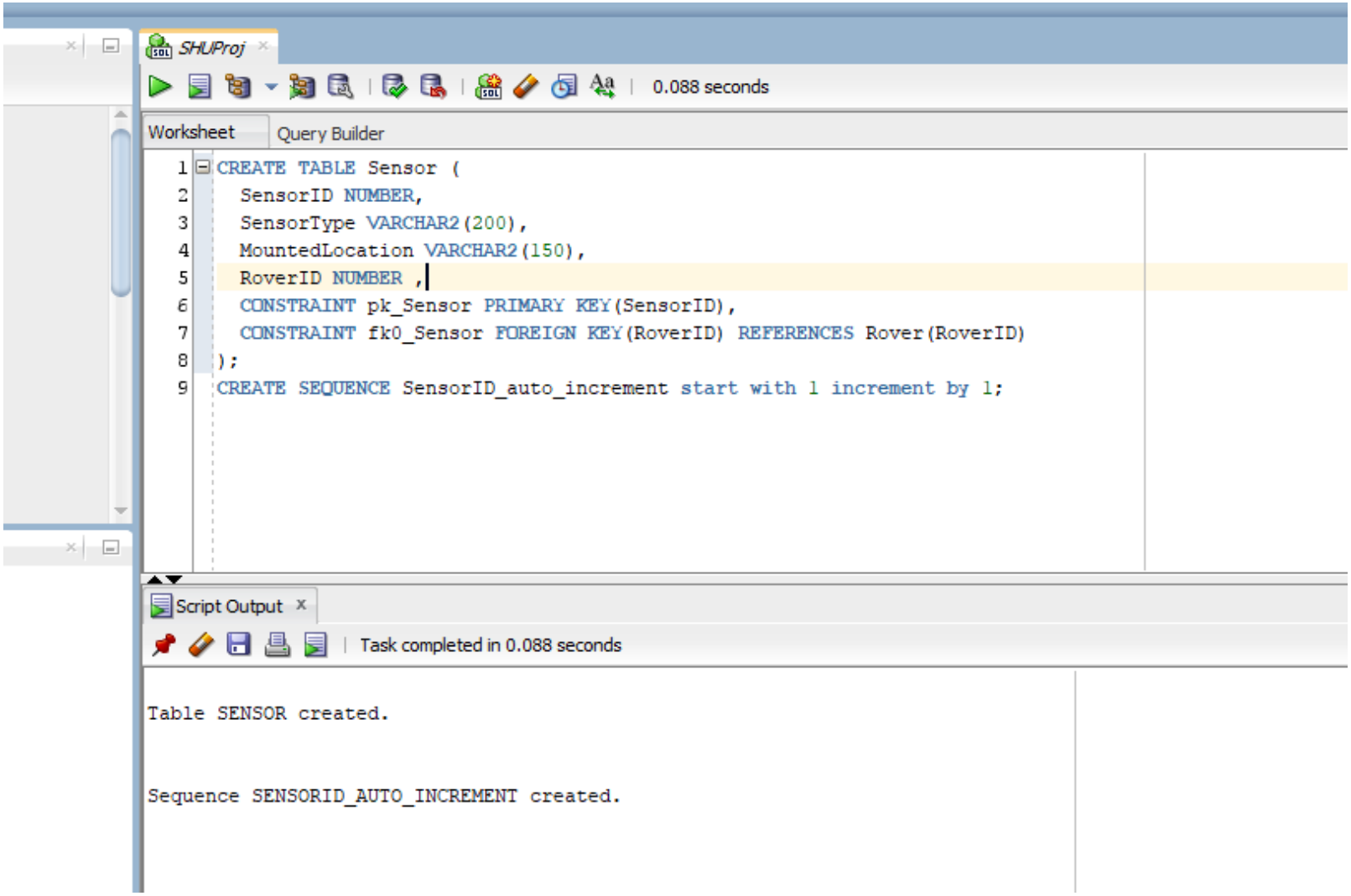
Camera Table



Instrument Table



Sensor Table



5. Rover DML

Camera

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (24, 'Mast Cam - Mast Cam Details', ' Up', 27);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (22, 'Hazard - Hazard Details', 'Right', 27);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (23, 'Nav Cam - Nav Cam Details', ' Left', 27);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (25, 'Mahli - Mahli Details', ' Bottom', 27);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (26, 'Rmi - Rmi Details', 'Bottom', 28);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (27, 'Mahli - Mahli Details', ' Up', 28);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (28, 'Rmi - Rmi Details', 'left', 29);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (29, 'Hazard - Hazard Details', ' bottom', 29);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (30, 'Mast Cam - Mast Cam Details', 'left', 30);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (31, 'Mardi - Mardi Details', ' Bottom', 30);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (32, 'Mahli - Mahli Details', 'Left', 31);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (33, 'Hazard - Hazard Details', ' Right', 31);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (34, 'Mardi - Mardi Details', 'Bottom', 32);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (35, 'Mardi - Mardi Details', ' Up', 32);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (36, 'Hazard - Hazard Details', 'Left', 33);

INSERT INTO CAMERA (CAMERAID, CAMERATYPE, MOUNTEDLOCATION, ROVERID) VALUES (37, 'Mast Cam - Mast Cam Details', ' Right', 33);

Instrument

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (24, 'Drill - Drill Details', ' Bottom', 27);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (25, 'Brush - Brush Details', 'Right', 28);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (22, 'Laser - Laser Details', 'Left', 27);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (23, 'Brush - Brush Details', ' Right', 27);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (26, 'Laser - Laser Details', ' bottom', 28);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (27, 'Brush - Brush Details', 'Right', 29);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (28, 'Drill - Drill Details', 'Left', 30);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (29, 'Laser - Laser Details', ' Right', 30);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (30, 'Laser - Laser Details', 'Bottom', 31);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (31, 'Laser - Laser Details', ' Left', 31);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (32, 'Laser - Laser Details', 'Left', 32);

INSERT INTO INSTRUMENT (INSTRUMENTID, INSTRUMENTTYPE, MOUNTEDLOCATION, ROVERID) VALUES (33, 'Laser - Laser Details', 'Left', 33);

Objective

INSERT INTO OBJECTIVE (OBJECTIVEID, OBJECTIVETYPE, COMPUTERID) VALUES (30, 'Biological', 22);

INSERT INTO OBJECTIVE (OBJECTIVEID, OBJECTIVETYPE, COMPUTERID) VALUES (32, 'Geological', 28);

INSERT INTO OBJECTIVE (OBJECTIVEID, OBJECTIVETYPE, COMPUTERID) VALUES (31, 'Biological', 28);

Rover

INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE) VALUES (28, 'Mars 3, Prop-M rove', 15, 13, 10, '2018-03-04', '2018-07-28', 'mars', 'thermal');

INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE) VALUES (29, ' Pathfinder', 5.9, 8, 7, '2015-01-06', '2020-08-28', 'Ares Vallis', 'thermal');

INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE) VALUES (30, 'Beagle 2, ', 9, 8, 3, '2014-06-10', '2019-07-31', 'Green Valley', 'thermal');

INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE) VALUES (31, ' Spirit (MER-A)', 7, 10, 5, '2016-09-05', '2018-10-24', 'Olympus Mons', 'thermal');

INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE) VALUES (32, 'Opportunity', 45, 13, 12, '2010-10-06', '2017-05-09', 'Gusev Crater', 'thermal');

INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE) VALUES (27, 'Mars 2, Prop-M rove', 4.5, 10, 2, '2018-07-04', '2018-07-20', 'mars', 'thermal');

INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE) VALUES (33, 'Curiosity', 6, 12, 7, '2011-11-26', '2012-08-06', 'Gale Crater', 'thermal');

Rover Computer

INSERT INTO ROVERCOMPUTER (COMPUTERID, OPERATINGSYSTEM, RAM, MEMORYCAPACITY, ROVERID) VALUES (24, 'linux', 30, 34, 29);

INSERT INTO ROVERCOMPUTER (COMPUTERID, OPERATINGSYSTEM, RAM, MEMORYCAPACITY, ROVERID) VALUES (25, 'mac', 13, 35, 30);

INSERT INTO ROVERCOMPUTER (COMPUTERID, OPERATINGSYSTEM, RAM, MEMORYCAPACITY, ROVERID) VALUES (26, 'mac', 12, 34, 31);

INSERT INTO ROVERCOMPUTER (COMPUTERID, OPERATINGSYSTEM, RAM, MEMORYCAPACITY, ROVERID) VALUES (22, 'mac', 12, 13, 27);

INSERT INTO ROVERCOMPUTER (COMPUTERID, OPERATINGSYSTEM, RAM, MEMORYCAPACITY, ROVERID) VALUES (23, 'linux', 12, 40, 28);

INSERT INTO ROVERCOMPUTER (COMPUTERID, OPERATINGSYSTEM, RAM, MEMORYCAPACITY, ROVERID) VALUES (27, 'mac', 7, 4, 32);

INSERT INTO ROVERCOMPUTER (COMPUTERID, OPERATINGSYSTEM, RAM, MEMORYCAPACITY, ROVERID) VALUES (28, 'mac', 2, 22, 33);

INSERT INTO ROVERCOMPUTER (COMPUTERID, OPERATINGSYSTEM, RAM, MEMORYCAPACITY, ROVERID) VALUES (29, 'linux', 345, 569, 34);

Task

INSERT INTO TASK (TASKID, TASKDETAILS, OBJECTIVEID) VALUES (32, ' Determine the nature and inventory of organic carbon compounds ', 30);

INSERT INTO TASK (TASKID, TASKDETAILS, OBJECTIVEID) VALUES (33, 'Investigate the chemical building blocks of life (carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulphur) ', 31);

INSERT INTO TASK (TASKID, TASKDETAILS, OBJECTIVEID) VALUES (34, ' Identify features that may represent the effects of biological processes (biosignatures and biomolecules) ', 31);

INSERT INTO TASK (TASKID, TASKDETAILS, OBJECTIVEID) VALUES (35, ' Investigate the chemical, isotopic, and mineralogical composition of the Martian surface and near-surface geological materials ', 32);

Rover Map

INSERT INTO ROVERMAP (MAPID, CURRENTPOSITION, TRAVERSALPATH, TRAVERSALDISTANCE, ROVERID) VALUES (27, 'mass', null, null, 28);

INSERT INTO ROVERMAP (MAPID, CURRENTPOSITION, TRAVERSALPATH, TRAVERSALDISTANCE, ROVERID) VALUES (28, 'Ares Vallis', null, null, 29);

INSERT INTO ROVERMAP (MAPID, CURRENTPOSITION, TRAVERSALPATH, TRAVERSALDISTANCE, ROVERID) VALUES (29, 'Green Valley', null, null, 30);

INSERT INTO ROVERMAP (MAPID, CURRENTPOSITION, TRAVERSALPATH, TRAVERSALDISTANCE, ROVERID) VALUES (26, 'mars', 'Gale Crator,Mountan Sharp', 1850, 27);

INSERT INTO ROVERMAP (MAPID, CURRENTPOSITION, TRAVERSALPATH, TRAVERSALDISTANCE, ROVERID) VALUES (30, 'Olympus Mons', null, null, 31);

INSERT INTO ROVERMAP (MAPID, CURRENTPOSITION, TRAVERSALPATH, TRAVERSALDISTANCE, ROVERID) VALUES (31, 'Gusev Crater', null, null, 32);

INSERT INTO ROVERMAP (MAPID, CURRENTPOSITION, TRAVERSALPATH, TRAVERSALDISTANCE, ROVERID) VALUES (32, 'Gale Crater', 'Mountan Sharp', 0, 33);

INSERT INTO ROVERMAP (MAPID, CURRENTPOSITION, TRAVERSALPATH, TRAVERSALDISTANCE, ROVERID) VALUES (33, 'TestPlace', null, null, 34);

Sensor

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (23, 'Ground Temperature Sensor - Ground Temperature Sensor Details', 'Left', 27);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (24, 'Wind Sensor - Wind Sensor Details', ' Right', 27);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (25, 'Air Temperature Sensor - Air Temperature Sensor Details', 'Bottom', 27);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (26, 'Uv Sensor - Uv Sensor Details', ' Up', 27);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (27, 'Ground Temperature Sensor - Ground Temperature Sensor Details', 'Left', 28);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (28, 'Wind Sensor - Wind Sensor Details', ' Right', 28);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (29, 'Air Temperature Sensor - Air Temperature Sensor Details', 'left', 29);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (30, 'Air Temperature Sensor - Air Temperature Sensor Details', ' bottom', 29);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (31, 'Ground Temperature Sensor - Ground Temperature Sensor Details', ' right', 29);

INSERT INTO SENSOR (SENSORID, SENSORTYPE, MOUNTEDLOCATION, ROVERID) VALUES (32, 'Ground Temperature Sensor - Ground Temperature Sensor Details', 'Left', 30);

Transmission

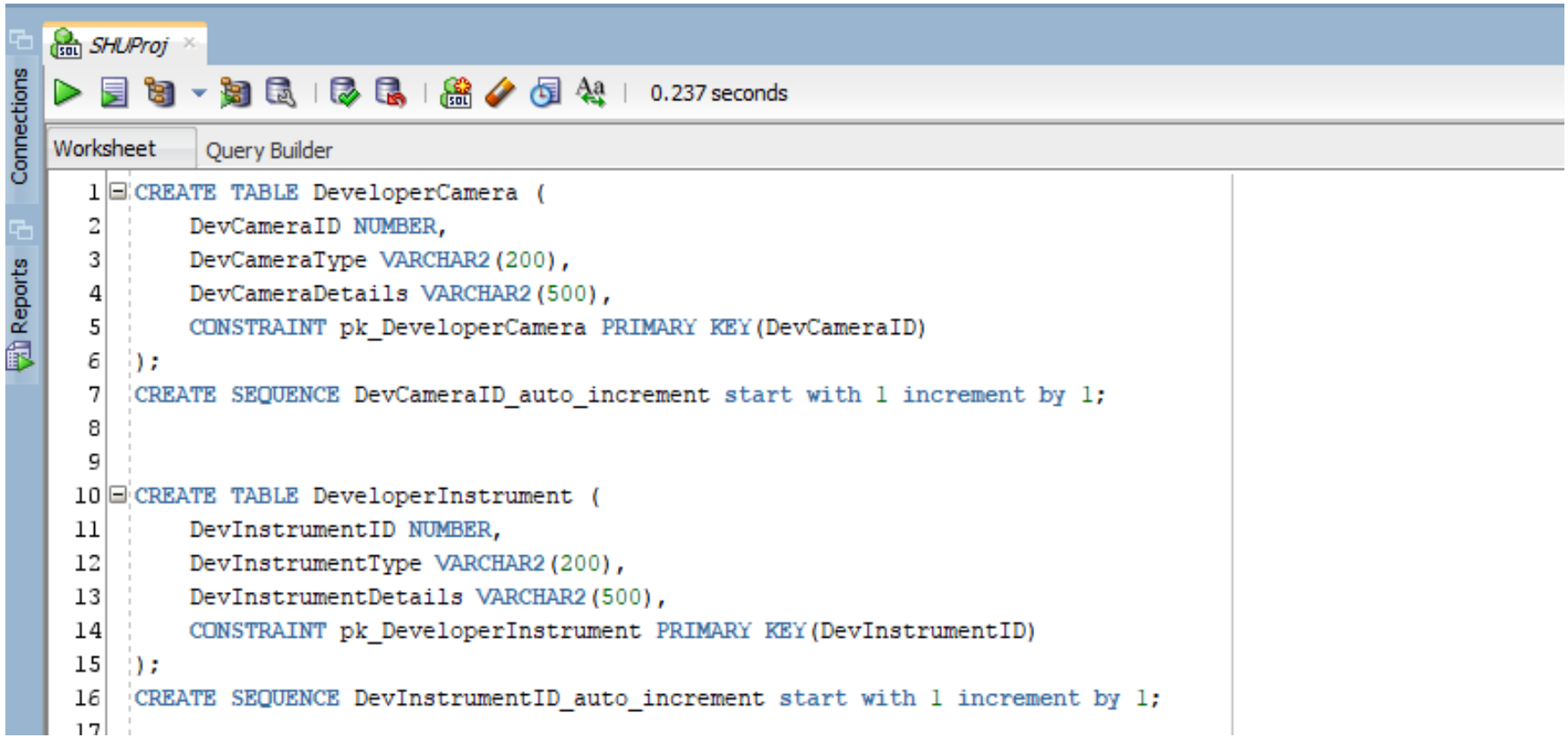
INSERT INTO TRANSMISSION (TRANSMISSIONID, RECEIVER, MESSAGE, TRANSMISSIONDATE) VALUES (1, 'DSN', 'hhhhhh', '2017.05.29');

INSERT INTO TRANSMISSION (TRANSMISSIONID, RECEIVER, MESSAGE, TRANSMISSIONDATE) VALUES (2, 'DSN', '[object Object],[object Object],[object Object],[object Object],[object Object],[object Object],[object Object],[object Object]', 'Fri Jul 06 2018 16:08:34 GMT+0530 (India Standard Time)');

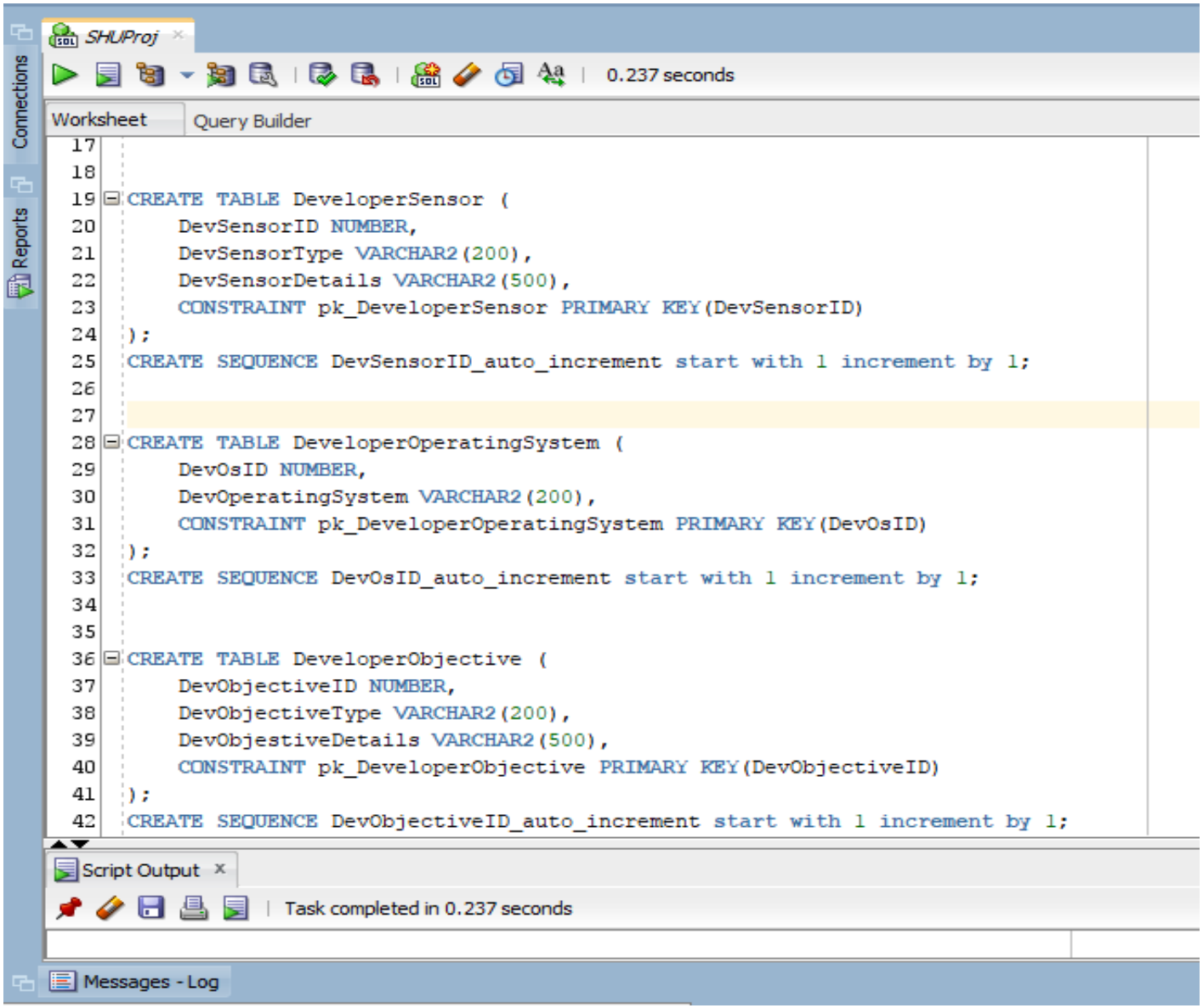
INSERT INTO TRANSMISSION (TRANSMISSIONID, RECEIVER, MESSAGE, TRANSMISSIONDATE) VALUES (3, 'DSN', 'Mountan Sharp,Valles Marineris,[object Object],[object Object],[object Object]', 'Fri Jul 06 2018 16:14:24 GMT+0530 (India Standard Time)');

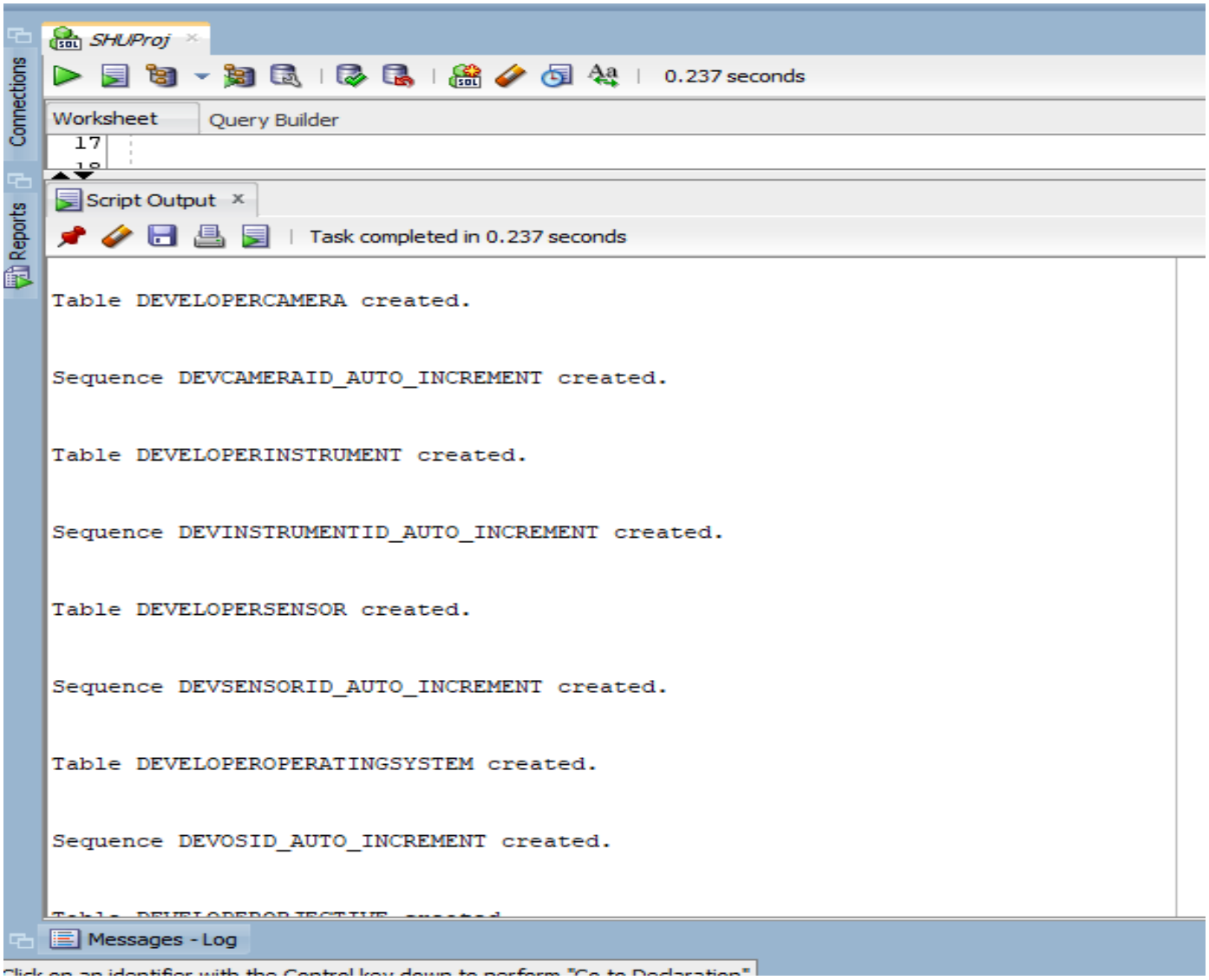
Developer Tables

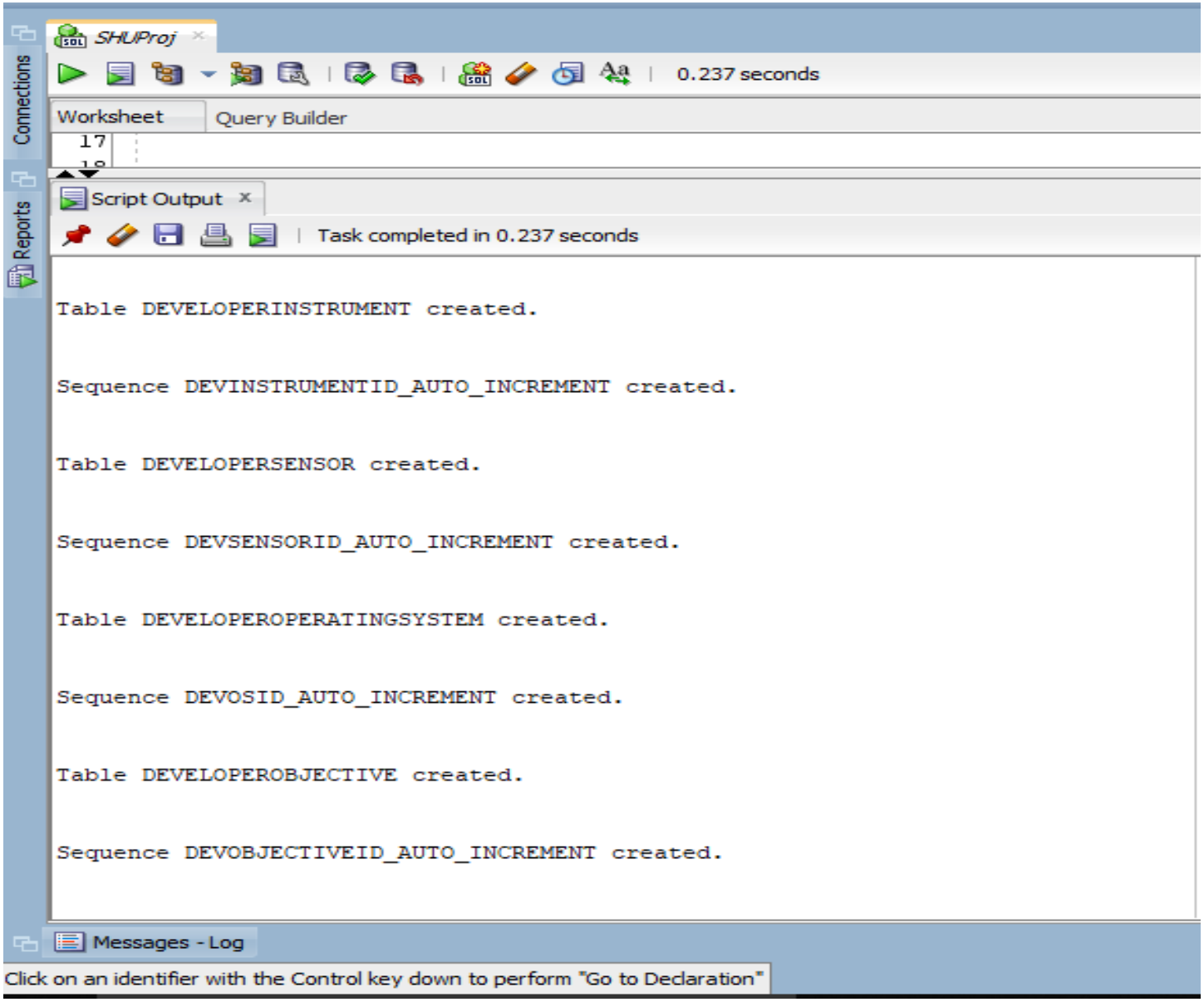
The following tables, such as DeveloperCamera and DeveloperInstrument, themselves do not have any direct relationship with the Rover tables. Their purpose is to provide the dropdown menu data for the system. For example, Sensor Types when adding sensors during Rover setup.




```
1  CREATE TABLE DeveloperCamera (
2      DevCameraID NUMBER,
3      DevCameraType VARCHAR2(200),
4      DevCameraDetails VARCHAR2(500),
5      CONSTRAINT pk_DeveloperCamera PRIMARY KEY(DevCameraID)
6  );
7  CREATE SEQUENCE DevCameraID_auto_increment start with 1 increment by 1;
8
9
10 CREATE TABLE DeveloperInstrument (
11     DevInstrumentID NUMBER,
12     DevInstrumentType VARCHAR2(200),
13     DevInstrumentDetails VARCHAR2(500),
14     CONSTRAINT pk_DeveloperInstrument PRIMARY KEY(DevInstrumentID)
15 );
16 CREATE SEQUENCE DevInstrumentID_auto_increment start with 1 increment by 1;
```


SHUProj
0.237 seconds
Worksheet
Query Builder
Connections
Reports
17
18
19 CREATE TABLE DeveloperSensor (
20 DevSensorID NUMBER,
21 DevSensorType VARCHAR2(200),
22 DevSensorDetails VARCHAR2(500),
23 CONSTRAINT pk_DeveloperSensor PRIMARY KEY(DevSensorID)
24);
25 CREATE SEQUENCE DevSensorID_auto_increment start with 1 increment by 1;
26
27
28 CREATE TABLE DeveloperOperatingSystem (
29 DevOsID NUMBER,
30 DevOperatingSystem VARCHAR2(200),
31 CONSTRAINT pk_DeveloperOperatingSystem PRIMARY KEY(DevOsID)
32);
33 CREATE SEQUENCE DevOsID_auto_increment start with 1 increment by 1;
34
35
36 CREATE TABLE DeveloperObjective (
37 DevObjectiveID NUMBER,
38 DevObjectiveType VARCHAR2(200),
39 DevObjestiveDetails VARCHAR2(500),
40 CONSTRAINT pk_DeveloperObjective PRIMARY KEY(DevObjectiveID)
41);
42 CREATE SEQUENCE DevObjectiveID_auto_increment start with 1 increment by 1;
Script Output
Task completed in 0.237 seconds
Messages - Log

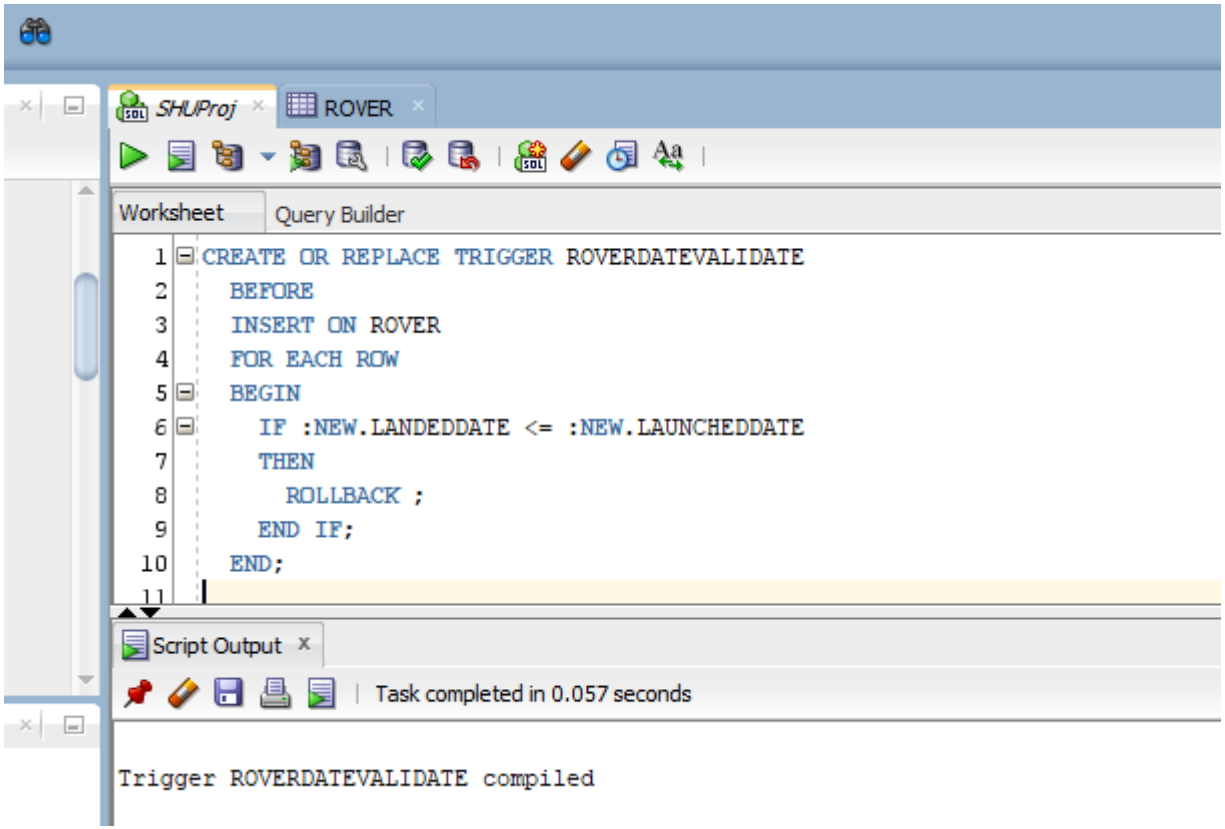

SHUProj
0.237 seconds
Worksheet
Query Builder
17
Script Output
Task completed in 0.237 seconds
Table DEVELOPERCAMERA created.
Sequence DEVCAMERAID_AUTO_INCREMENT created.
Table DEVELOPERINSTRUMENT created.
Sequence DEVINSTRUMENTID_AUTO_INCREMENT created.
Table DEVELOPERSENSOR created.
Sequence DEVSENSORID_AUTO_INCREMENT created.
Table DEVELOPEROPERATINGSYSTEM created.
Sequence DEVOSID_AUTO_INCREMENT created.
Messages - Log
Connections
Reports


SHUProj
0.237 seconds
Worksheet
Query Builder
17
Script Output
Task completed in 0.237 seconds
Table DEVELOPERINSTRUMENT created.
Sequence DEVINSTRUMENTID_AUTO_INCREMENT created.
Table DEVELOPERSENSOR created.
Sequence DEVSENSORID_AUTO_INCREMENT created.
Table DEVELOPEROPERATINGSYSTEM created.
Sequence DEVOSID_AUTO_INCREMENT created.
Table DEVELOPEROBJECTIVE created.
Sequence DEVOBJECTIVEID_AUTO_INCREMENT created.
Messages - Log
Click on an identifier with the Control key down to perform "Go to Declaration"
Connections
Reports

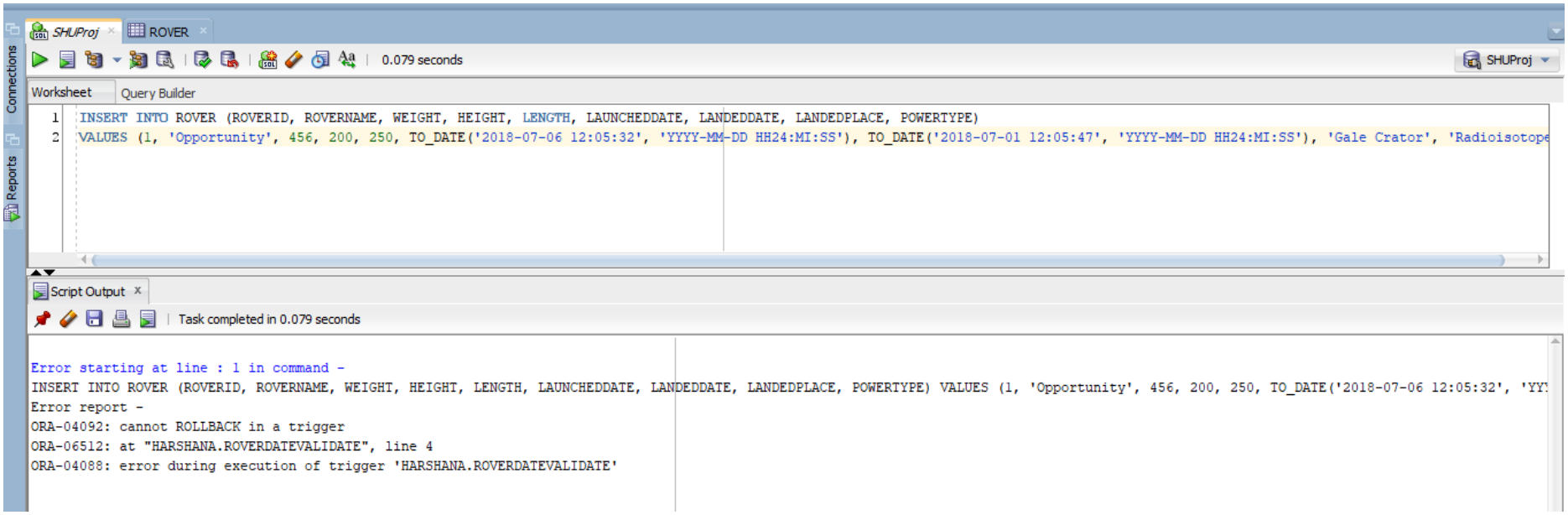
6. Triggers

Validating Rover Dates

If Rover Landed date is less than or equal to the Launched date, then Rollback.

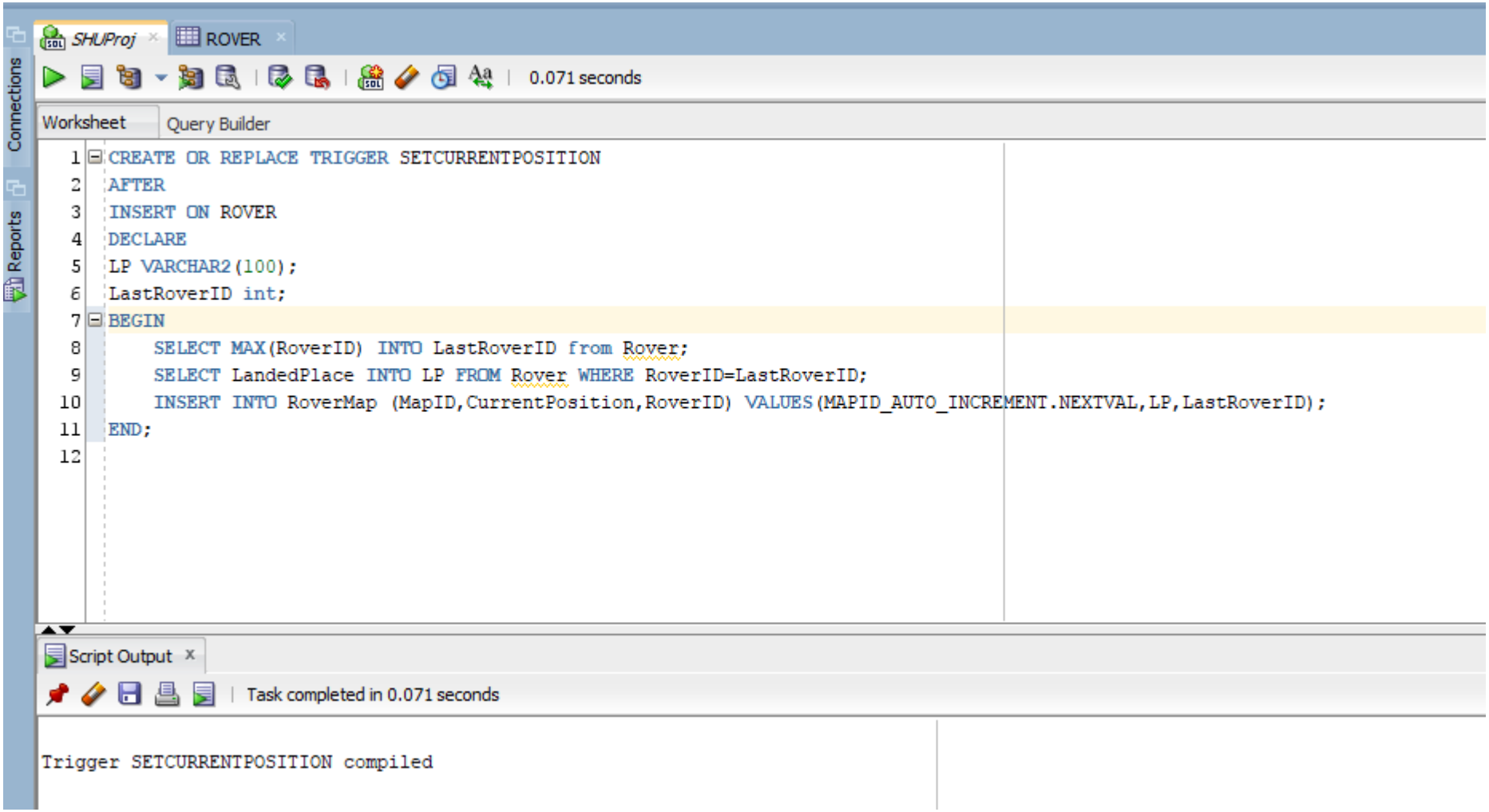


Result

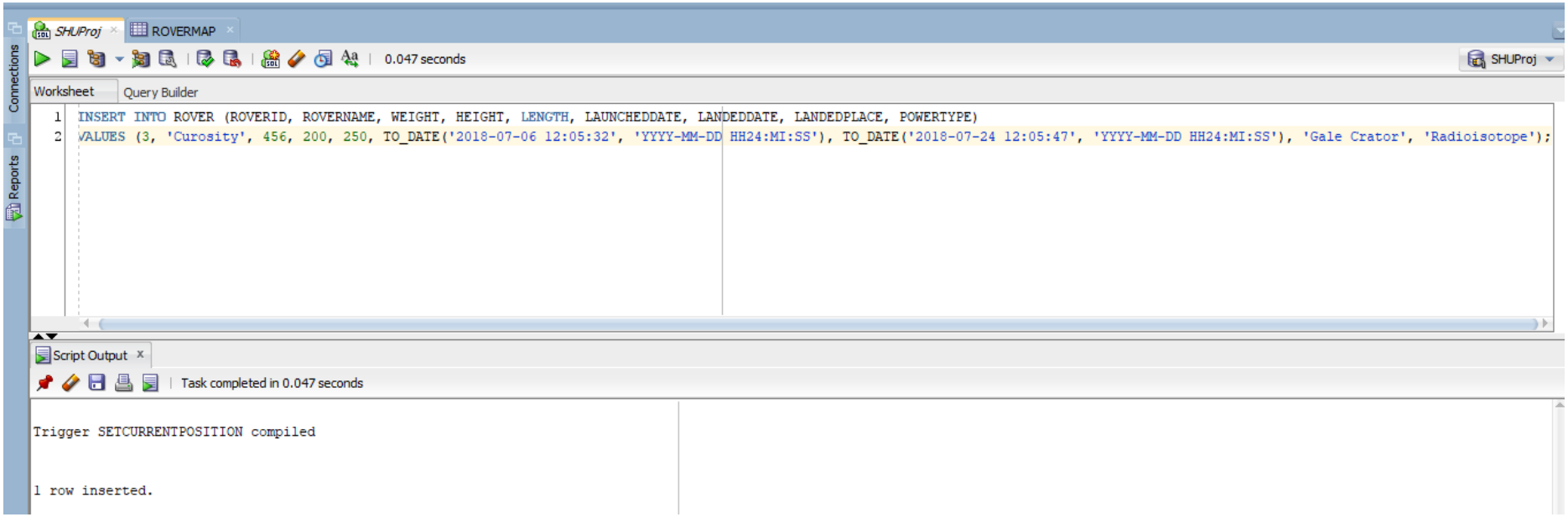

SHUProj
ROVER
0.079 seconds
SHUProj
Worksheet
Query Builder
1 INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE)
2 VALUES (1, 'Opportunity', 456, 200, 250, TO_DATE('2018-07-06 12:05:32', 'YYYY-MM-DD HH24:MI:SS'), TO_DATE('2018-07-01 12:05:47', 'YYYY-MM-DD HH24:MI:SS'), 'Gale Crator', 'Radioisotope
Connections
Reports
Script Output
Task completed in 0.079 seconds
Error starting at line : 1 in command -
INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE) VALUES (1, 'Opportunity', 456, 200, 250, TO_DATE('2018-07-06 12:05:32', 'YY
Error report -
ORA-04092: cannot ROLLBACK in a trigger
ORA-06512: at "HARSHANA.ROVERDATEVALIDATE", line 4
ORA-04088: error during execution of trigger 'HARSHANA.ROVERDATEVALIDATE'

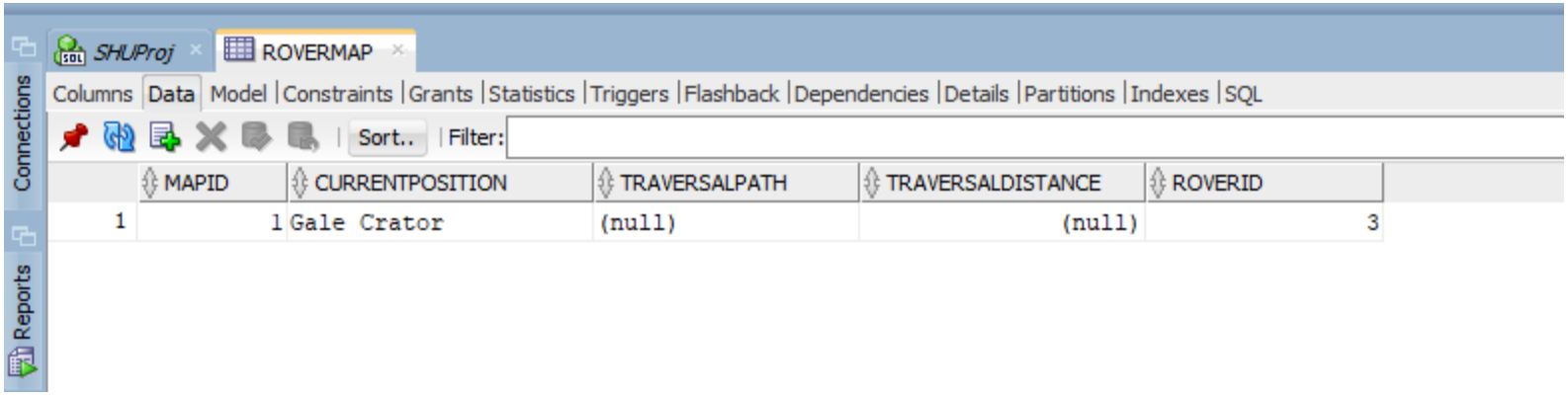
Setting Current Position

When inserting a new rover to the rover table, then retrieves it's inserted landed position and creates a map for the rover.



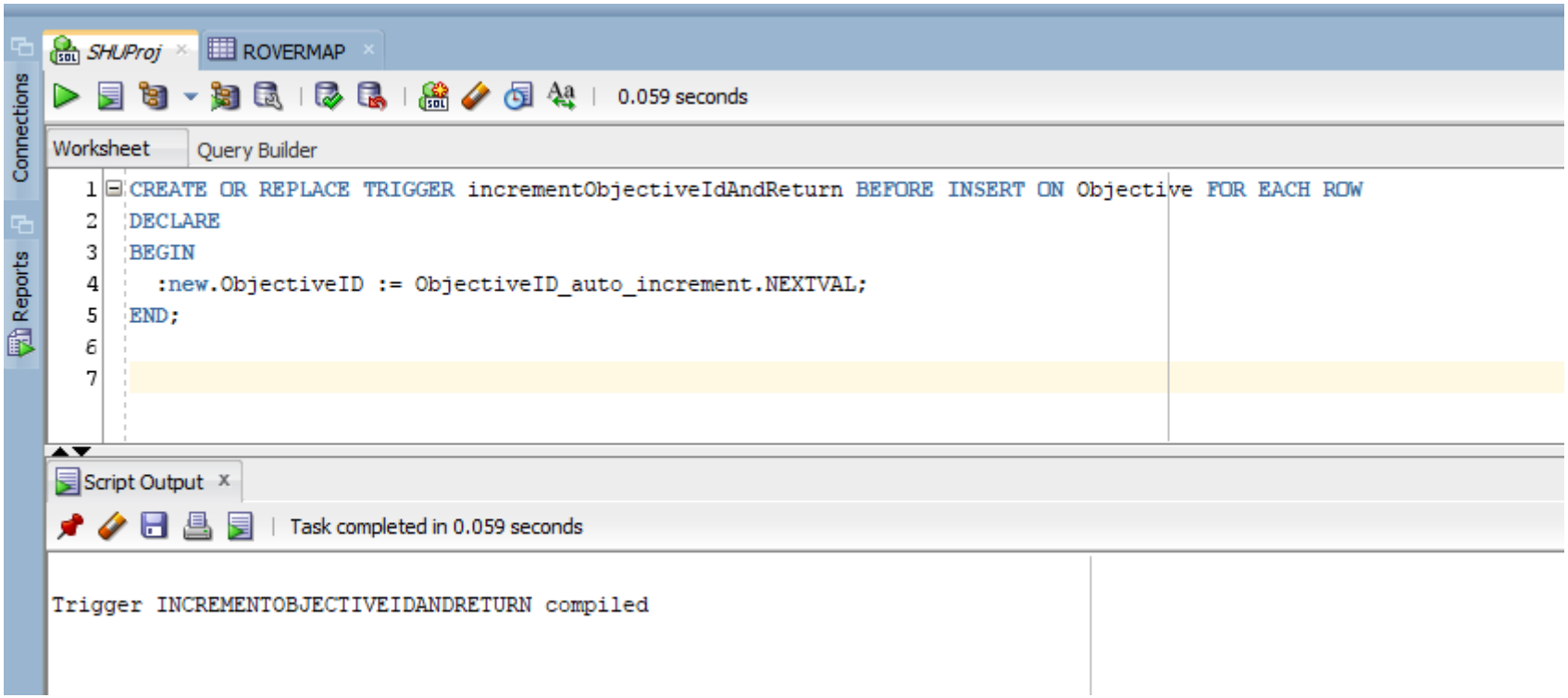
Result


SHUProj
ROVERMAP
0.047 seconds
SHUProj
Worksheet
Query Builder
1 INSERT INTO ROVER (ROVERID, ROVERNAME, WEIGHT, HEIGHT, LENGTH, LAUNCHEDDATE, LANDEDDATE, LANDEDPLACE, POWERTYPE)
2 VALUES (3, 'Curosity', 456, 200, 250, TO_DATE('2018-07-06 12:05:32', 'YYYY-MM-DD HH24:MI:SS'), TO_DATE('2018-07-24 12:05:47', 'YYYY-MM-DD HH24:MI:SS'), 'Gale Crator', 'Radioisotope');
Script Output
Task completed in 0.047 seconds
Trigger SETCURRENTPOSITION compiled
1 row inserted.


SHUProj
ROVERMAP
Columns
Data
Model
Constraints
Grants
Statistics
Triggers
Flashback
Dependencies
Details
Partitions
Indexes
SQL
Sort..
Filter:
MAPID
CURRENTPOSITION
TRAVERSALPATH
TRAVERSALDISTANCE
ROVERID
1
1
Gale Crator
(null)
(null)
3

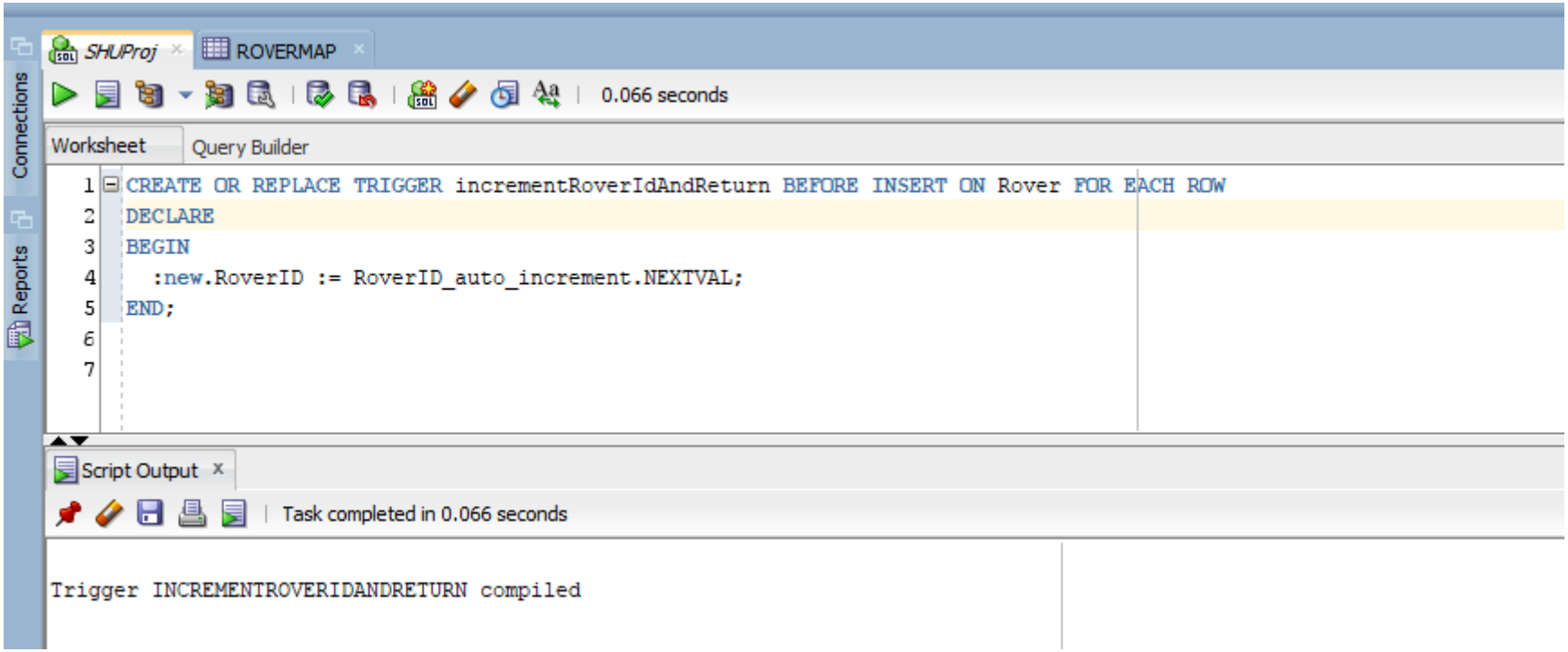
Increment Objective ID

When adding a new row to the objective table, increment the objective id and return it.



Increment the Rover ID

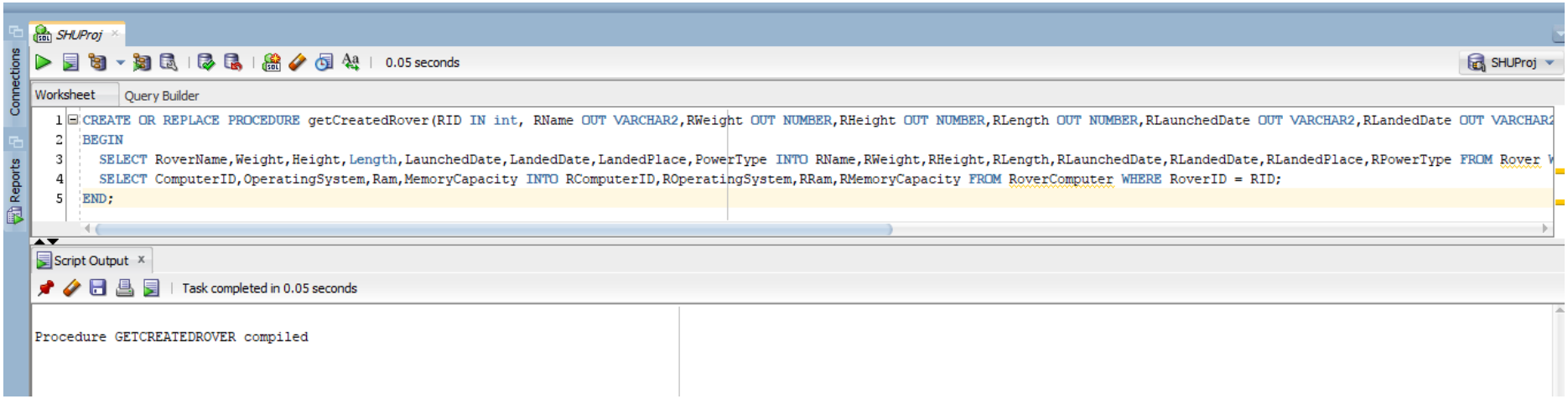
When adding a new row to the rover table, increment the rover id and return it.



7. Procedures

Get Created Rover

Get created rover and its rover computer details by giving rover id.

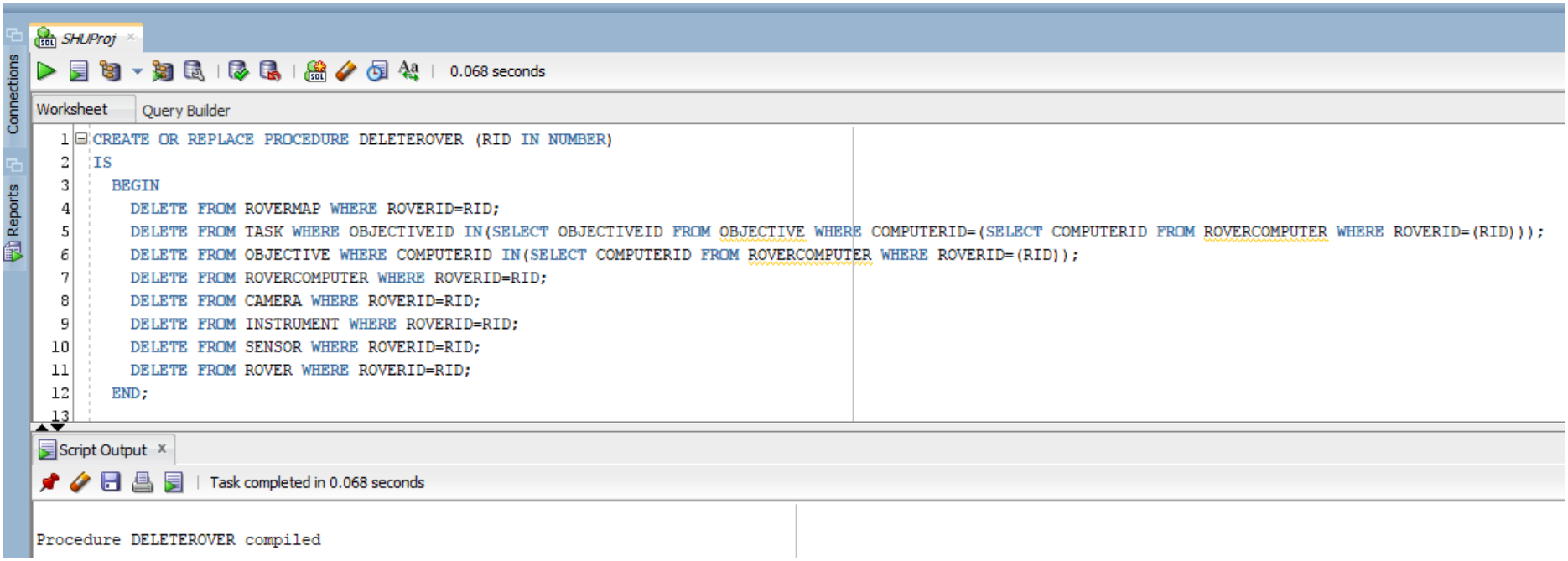


Get rover with computer ID frontend calling

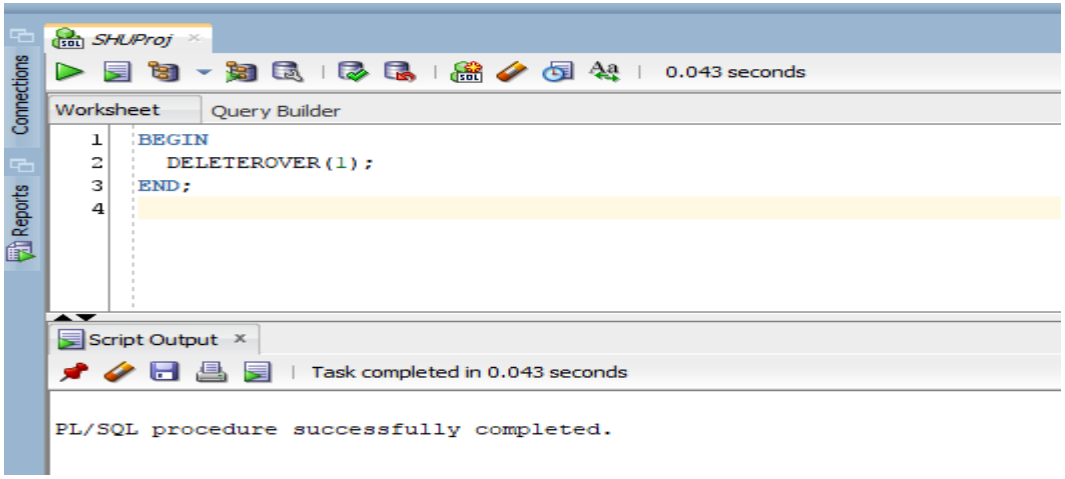
```
router.get("/getroverswithcomputerid/:rid",function(req,res){
    oracledb.getConnection(
        db,
        function(err, connection) {
            if (err) {
                console.error(err.message);
                return;
            }

            connection.execute(
                "BEGIN getCreatedRover(:RoverID,:RoverName,:Weight,:Height,:Length,:LaunchedDate,:LandedDate,:LandedPlace,:PowerType,:ComputerID,:Operating
                {  // bind variables
                    RoverID:   req.params.rid,
                    RoverName: { dir: oracledb.BIND_OUT, type: oracledb.STRING},
                    Weight: { dir: oracledb.BIND_OUT, type: oracledb.NUMBER},
                    Height: { dir: oracledb.BIND_OUT, type: oracledb.NUMBER},
                    Length: { dir: oracledb.BIND_OUT, type: oracledb.NUMBER},
                    LaunchedDate: { dir: oracledb.BIND_OUT, type: oracledb.STRING},
                    LandedDate: { dir: oracledb.BIND_OUT, type: oracledb.STRING},
                    LandedPlace: { dir: oracledb.BIND_OUT, type: oracledb.STRING},
                    PowerType: { dir: oracledb.BIND_OUT, type: oracledb.STRING},
                    ComputerID: { dir: oracledb.BIND_OUT, type: oracledb.NUMBER},
                    OperatingSystem: { dir: oracledb.BIND_OUT, type: oracledb.STRING},
                    Ram: { dir: oracledb.BIND_OUT, type: oracledb.NUMBER},
                    MemoryCapacity: { dir: oracledb.BIND_OUT, type: oracledb.NUMBER},
                },
                function(err, result) {
                    if (err) {
```

Delete Rover

Delete rover, its tasks, objectives, rover computer etc. by giving rover ID.



Result

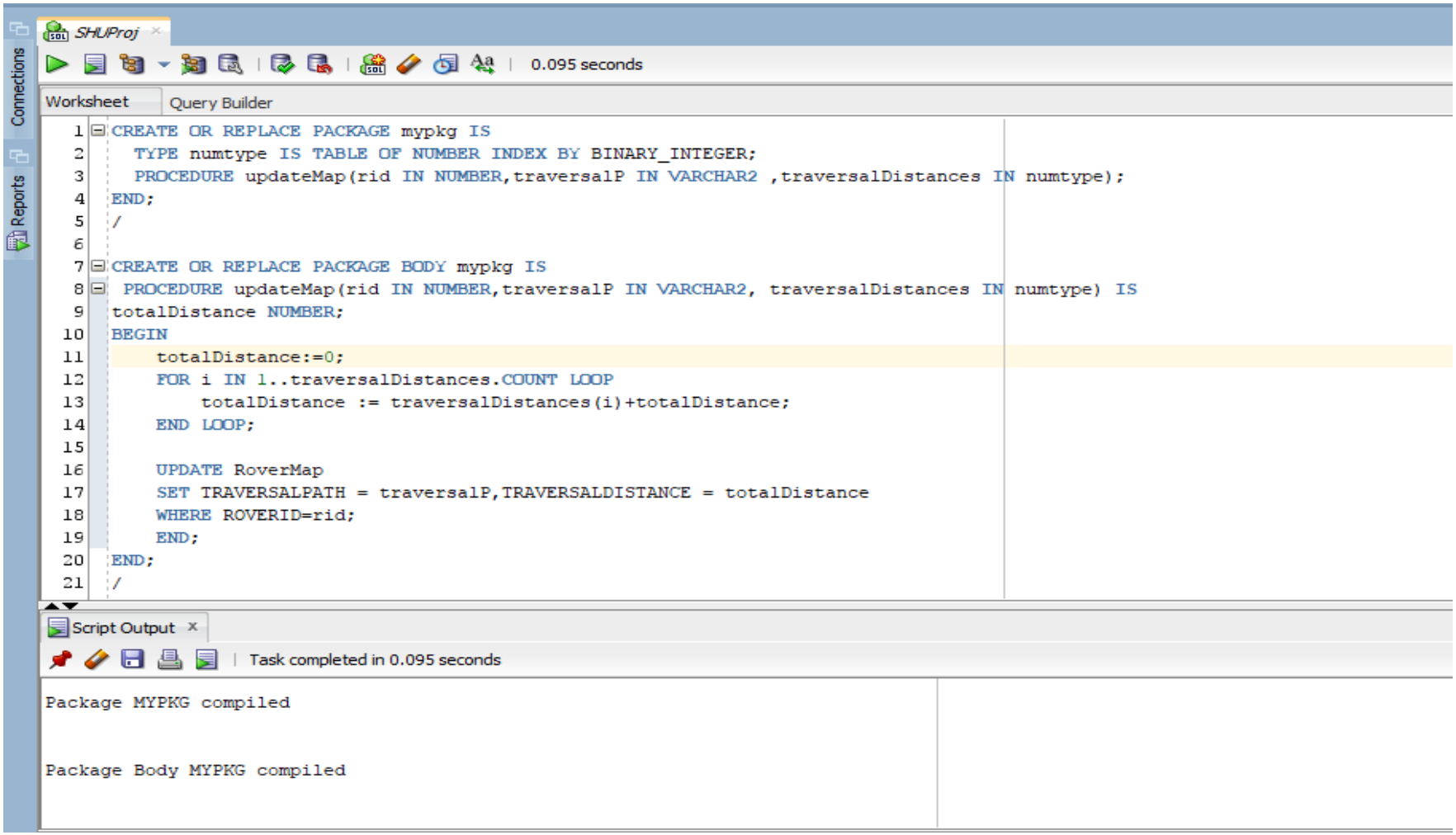

SHUProj
0.043 seconds
Worksheet
Query Builder
1 BEGIN
2 DELETEROVER(1);
3 END;
4
Connections
Reports
Script Output
Task completed in 0.043 seconds
PL/SQL procedure successfully completed.

Delete rover with rover ID frontend calling

```
router.delete("/roverdelete/:rid", function(req,res){
    oracledb.getConnection(
        db,
        function(err, connection) {
            if (err) {
                console.error(err.message);
                return;
            }
            connection.execute(
                "BEGIN DELETEROVER(:rid); END;",
                {
                    rid:req.params.rid
                },
                { autoCommit: true },
                function(err, result) {
                    if (err) {
                        console.error(err.message);
                        doRelease(connection);
                        return;
                    }
                    console.log(result);
                    doRelease(connection);
                });
        });
});
```

Update Map

Update map by passing traversal path and distance according to the rover id.

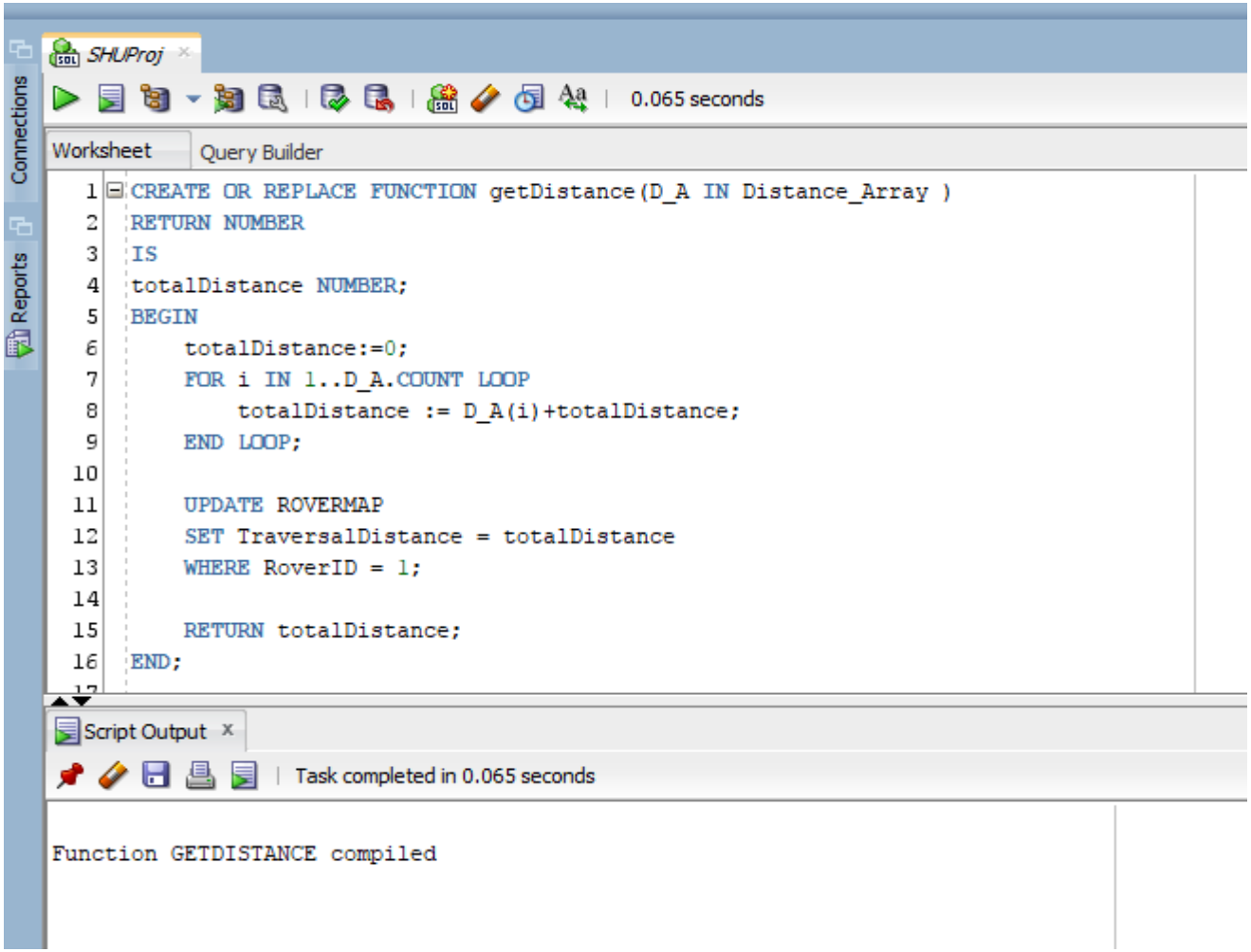


Update map calling

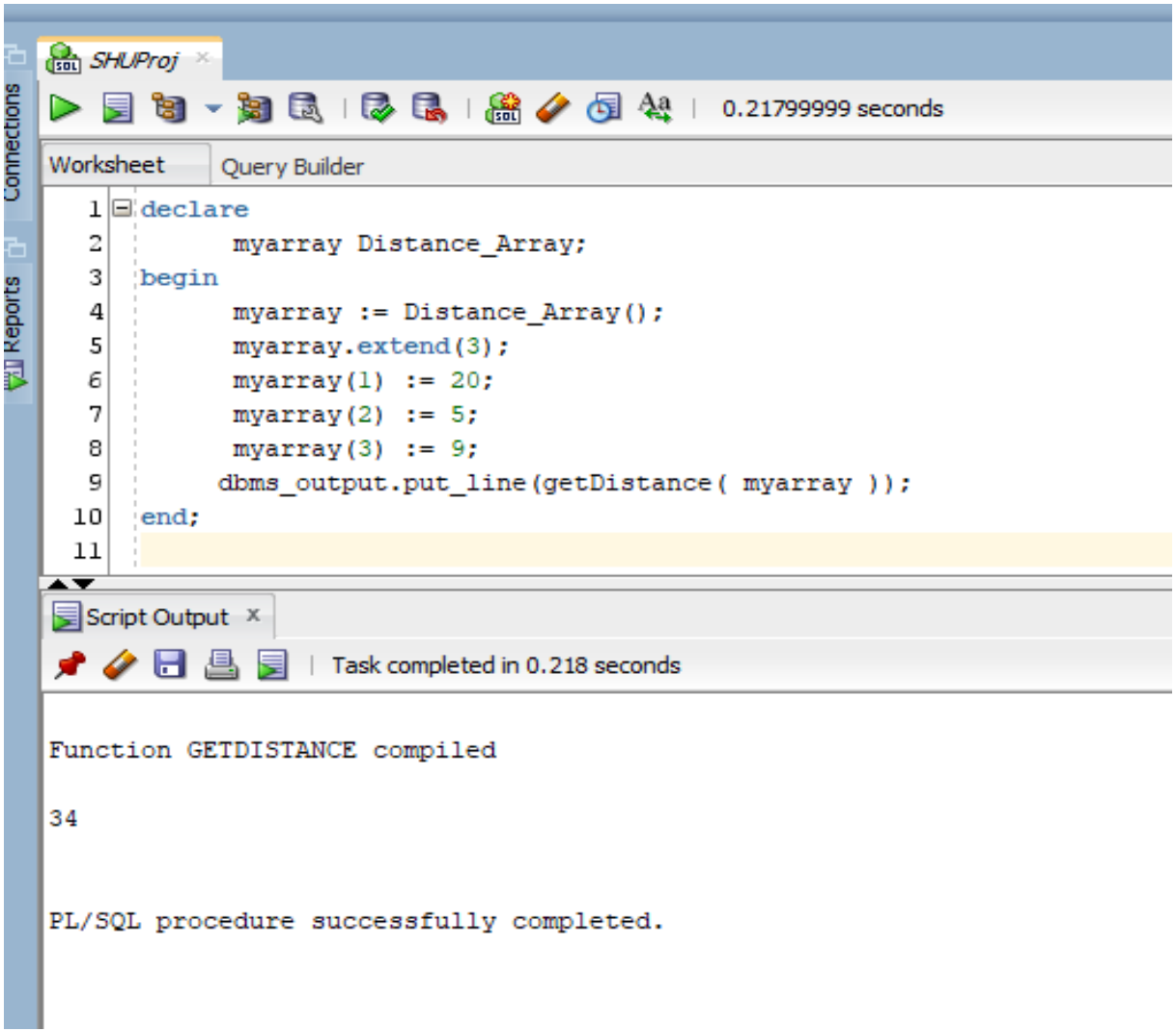
```
router.post("/updatemap",function(req,res){
    oracledb.getConnection(
        db,
        function(err, connection) {
            if (err) {
                console.error(err.message);
                return;
            }//console.log(req.body);
            connection.execute(
                "BEGIN mypkg.updateMap(:rid,:traversalP,:traversalDistances); END;",
                {
                    rid: req.body.rid,
                    traversalP:req.body.traversalPath,
                    traversalDistances: { type: oracledb.NUMBER,
                        dir: oracledb.BIND_IN,
                        val:req.body.traversalDistances
                    }
                },
                { autoCommit: true },
                function(err, result) {
                    if (err) {
                        console.error(err.message);
                        doRelease(connection);
                        return;
                    }
                    res.json(result);
                    doRelease(connection);
```

8. Functions

Get travel distance by given distance array.



Result

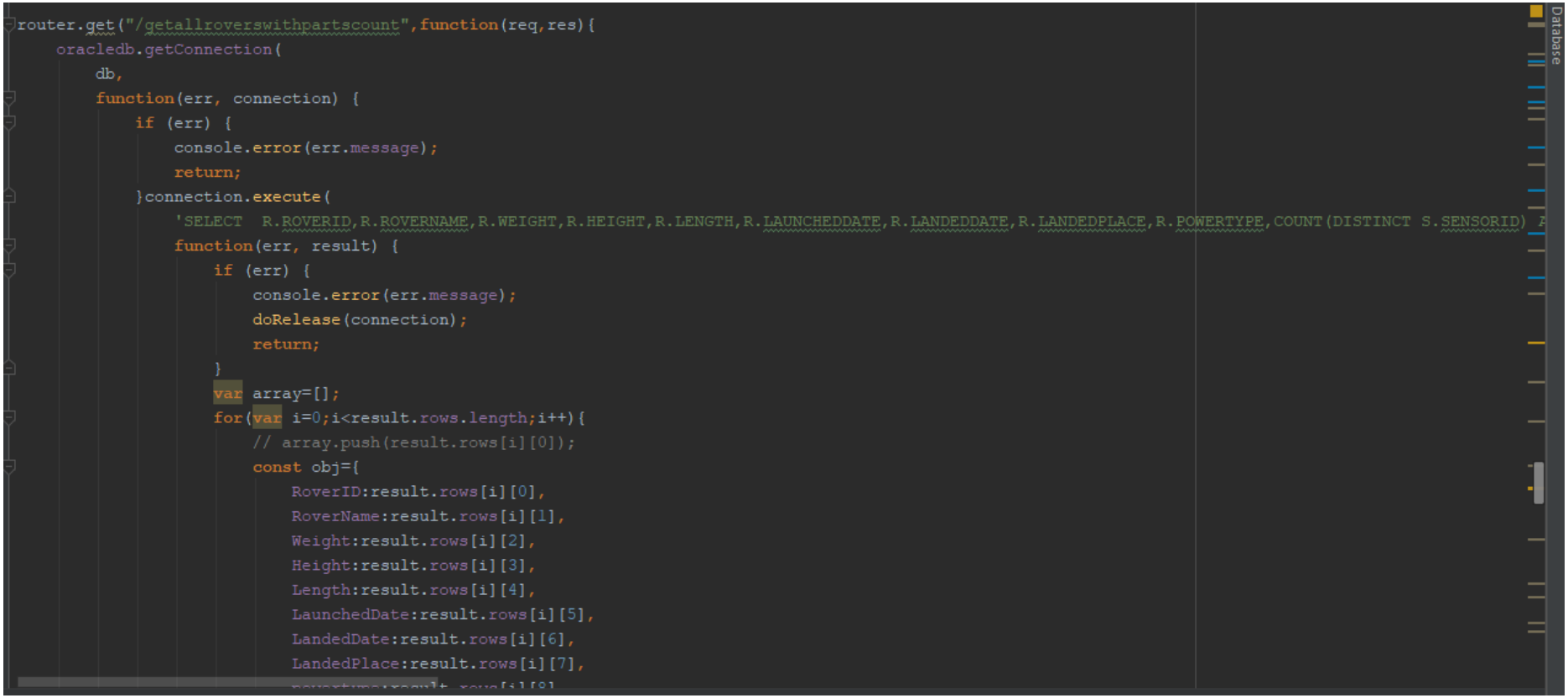

SHUProj
0.21799999 seconds
Worksheet
Query Builder
Connections
Reports
1 declare
2 myarray Distance_Array;
3 begin
4 myarray := Distance_Array();
5 myarray.extend(3);
6 myarray(1) := 20;
7 myarray(2) := 5;
8 myarray(3) := 9;
9 dbms_output.put_line(getDistance(myarray));
10 end;
11
Script Output
Task completed in 0.218 seconds
Function GETDISTANCE compiled
34
PL/SQL procedure successfully completed.

9. Front End Scripts

Add Cameras

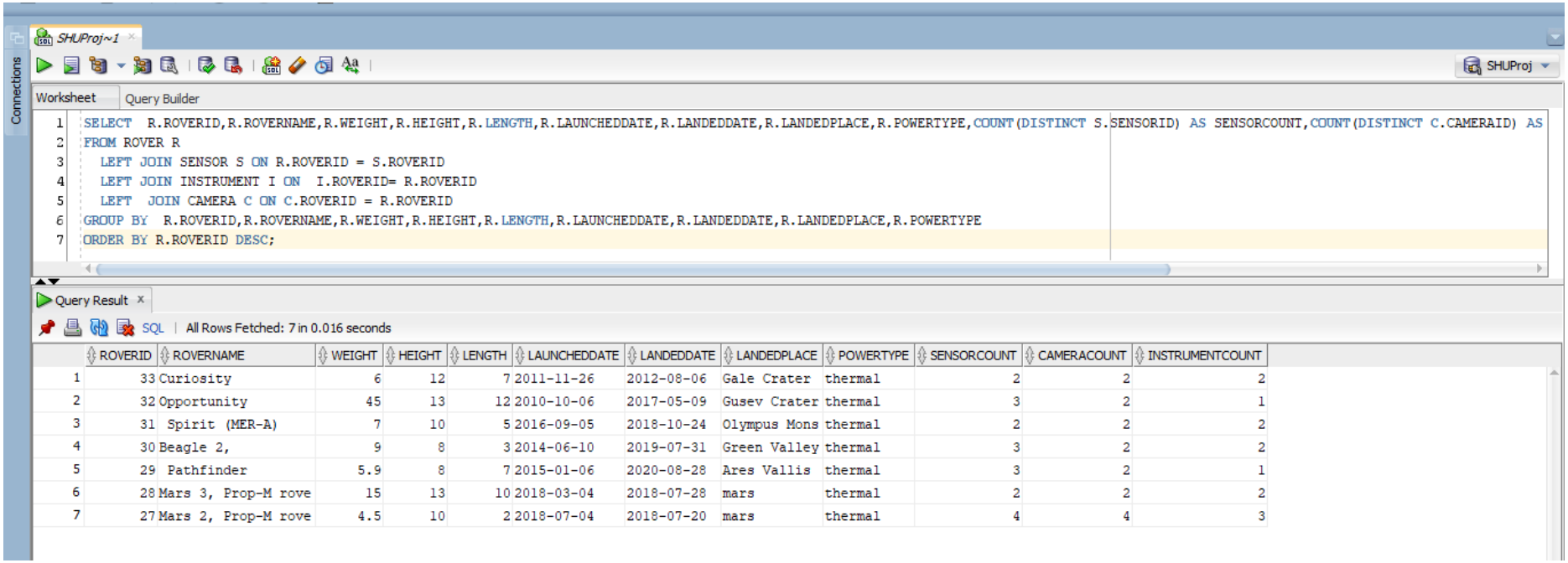
```
router.post("/addRovervision", function(req,res) {
    oracledb.getConnection(
        db,
        function(err, connection) {
            if (err) {
                console.error(err.message);
                return;
            }
            connection.execute(
                'INSERT INTO Camera VALUES(CameraID_auto_increment.nextval,:CameraType,:MountedLocation,:RoverID)',
                {
                    CameraType: req.body.CameraType,
                   // CameraCount:req.body.CameraCount,
                    MountedLocation:req.body.MountedLocation,
                    RoverID:req.body.RoverID
                 },
                { autoCommit: true },
                function(err, result) {
                    if (err) {
                        console.error(err.message);//TODO promt an error in front end when an error occurs
                        doRelease(connection);
                        return;
                    }
                    res.json(result);
                    doRelease(connection);
                });
        });
});
```

Get all rovers with parts count (Sensor count, Camera count, Instrument count)



```
router.get("/getallroverswithpartscount",function(req,res){
    oracledb.getConnection(
        db,
        function(err, connection) {
            if (err) {
                console.error(err.message);
                return;
            }connection.execute(
                'SELECT  R.ROVERID,R.ROVERNAME,R.WEIGHT,R.HEIGHT,R.LENGTH,R.LAUNCHEDDATE,R.LANDEDDATE,R.LANDEDPLACE,R.POWERTYPE,COUNT(DISTINCT S.SENSORID) A
                function(err, result) {
                    if (err) {
                        console.error(err.message);
                        doRelease(connection);
                        return;
                    }
                    var array=[];
                    for(var i=0;i<result.rows.length;i++){
                        // array.push(result.rows[i][0]);
                        const obj={
                            RoverID:result.rows[i][0],
                            RoverName:result.rows[i][1],
                            Weight:result.rows[i][2],
                            Height:result.rows[i][3],
                            Length:result.rows[i][4],
                            LaunchedDate:result.rows[i][5],
                            LandedDate:result.rows[i][6],
                            LandedPlace:result.rows[i][7],
```

SQL Query - Get all rovers with parts count (Sensor count, Camera count, Instrument count)



```
SELECT  R.ROVERID,R.ROVERNAME,R.WEIGHT,R.HEIGHT,R.LENGTH,R.LAUNCHEDDATE,R.LANDEDDATE,R.LANDEDPLACE,R.POWERTYPE,COUNT(DISTINCT S.SENSORID) AS SENSORCOUNT,COUNT(DISTINCT C.CAMERAID) AS
FROM ROVER R
  LEFT JOIN SENSOR S ON R.ROVERID = S.ROVERID
  LEFT JOIN INSTRUMENT I ON  I.ROVERID= R.ROVERID
  LEFT  JOIN CAMERA C ON C.ROVERID = R.ROVERID
GROUP BY  R.ROVERID,R.ROVERNAME,R.WEIGHT,R.HEIGHT,R.LENGTH,R.LAUNCHEDDATE,R.LANDEDDATE,R.LANDEDPLACE,R.POWERTYPE
ORDER BY R.ROVERID DESC;
```

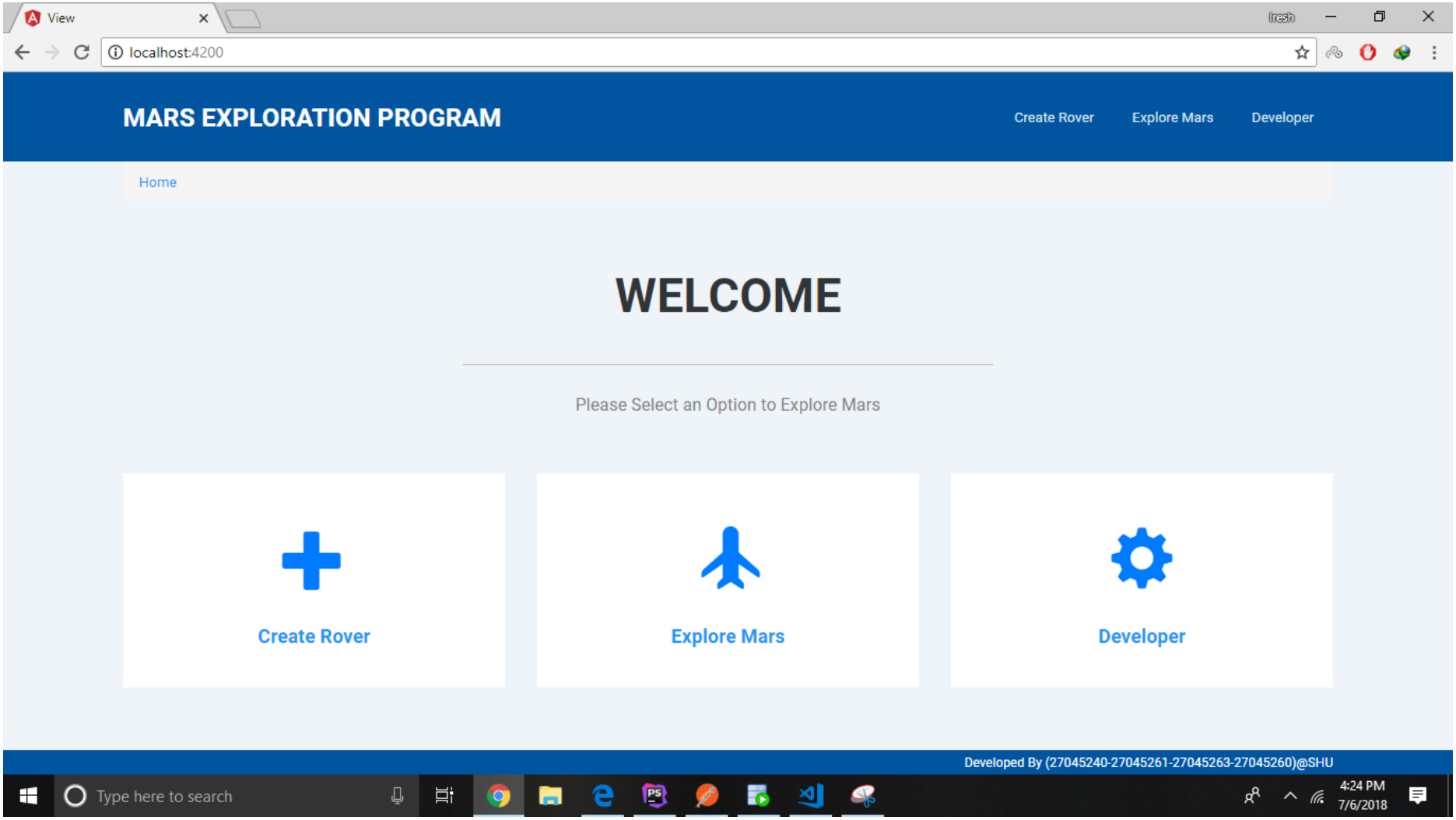
All Rows Fetched: 7 in 0.016 seconds

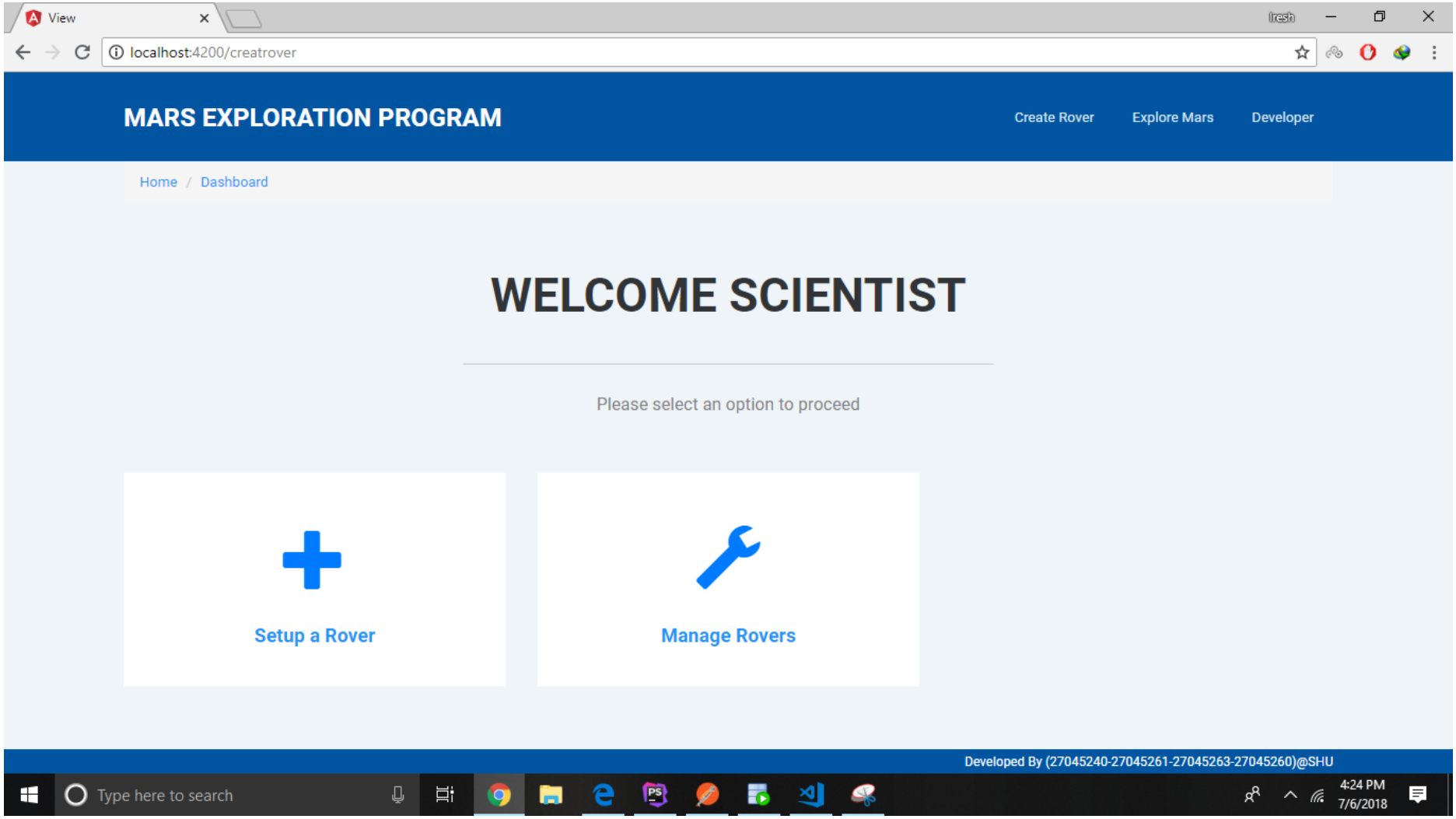
	ROVERID	ROVERNAME	WEIGHT	HEIGHT	LENGTH	LAUNCHEDDATE	LANDEDDATE	LANDEDPLACE	POWERTYPE	SENSORCOUNT	CAMERACOUNT	INSTRUMENTCOUNT
1	33	Curiosity	6	12	7	2011-11-26	2012-08-06	Gale Crater	thermal	2	2	2
2	32	Opportunity	45	13	12	2010-10-06	2017-05-09	Gusev Crater	thermal	3	2	1
3	31	Spirit (MER-A)	7	10	5	2016-09-05	2018-10-24	Olympus Mons	thermal	2	2	2
4	30	Beagle 2,	9	8	3	2014-06-10	2019-07-31	Green Valley	thermal	3	2	2
5	29	Pathfinder	5.9	8	7	2015-01-06	2020-08-28	Ares Vallis	thermal	3	2	1
6	28	Mars 3, Prop-M rove	15	13	10	2018-03-04	2018-07-28	mars	thermal	2	2	2
7	27	Mars 2, Prop-M rove	4.5	10	2	2018-07-04	2018-07-20	mars	thermal	4	4	3

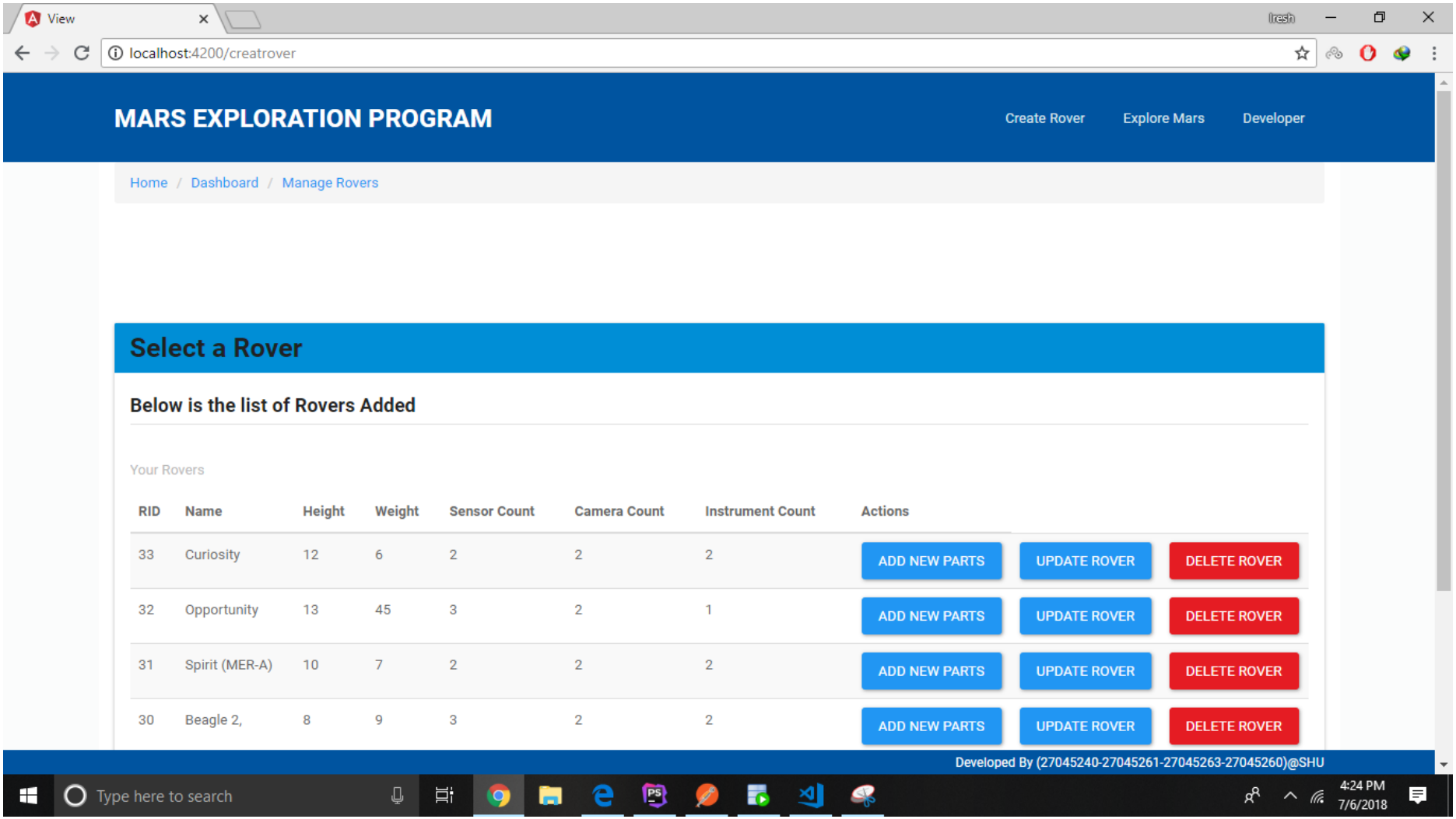
Update Rovers

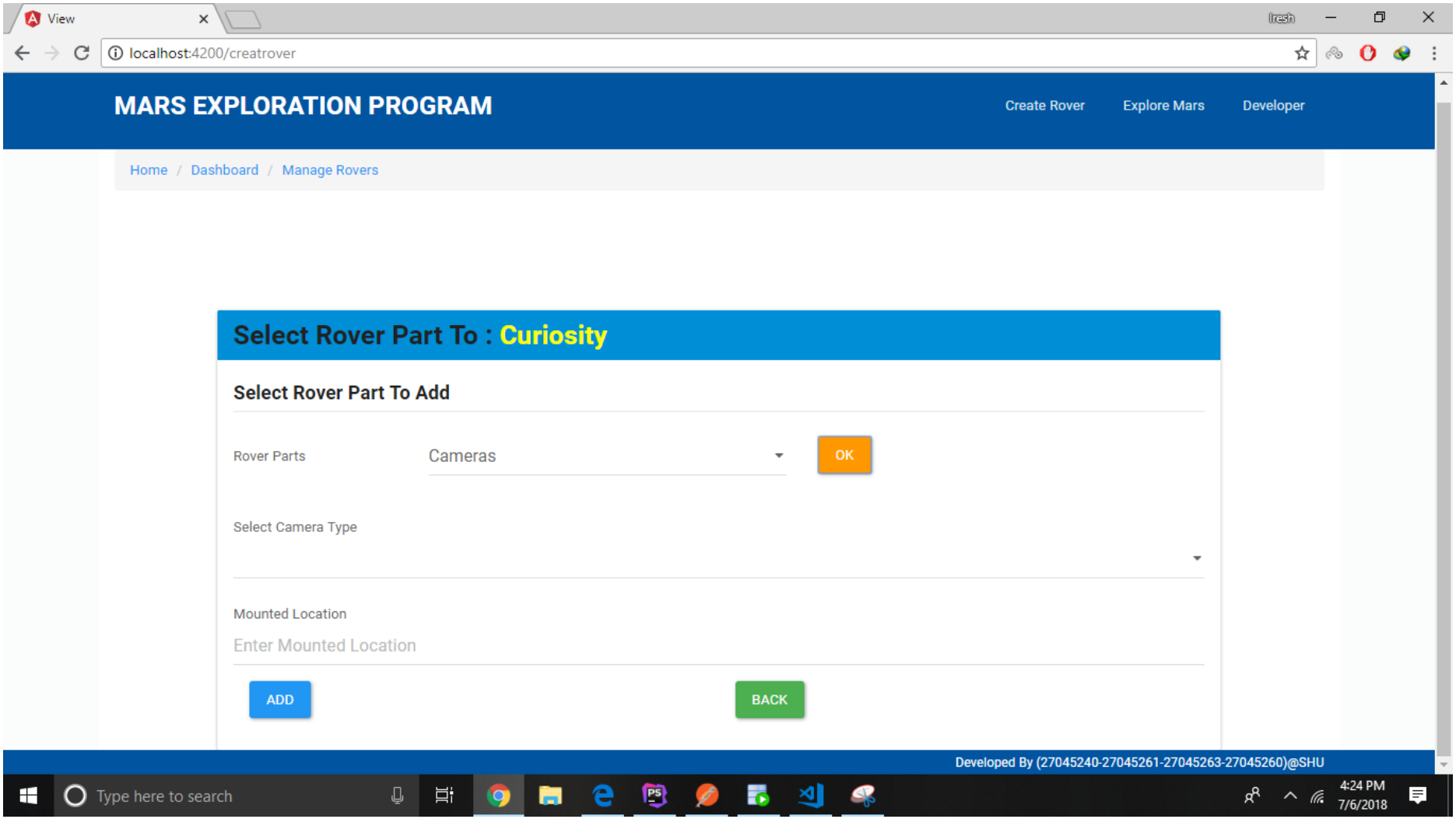
```
router.put("/updaterover", function(req,res){
    oracledb.getConnection(
        db,
        function(err, connection) {
            if (err) {
                console.error(err.message);
                return;
            }
            connection.execute(
                "UPDATE ROVER SET ROVERNAME = :RName,WEIGHT=:RWeight,HEIGHT=:RHeight,LENGTH=:RLength,POWERTYPE=:RPowerType WHERE ROVERID= :rid",
                {
                    rid:req.body.rid,
                    RName:req.body.RoverName,
                    RWeight:req.body.Weight,
                    RHeight:req.body.Height,
                    RLength:req.body.Length,
                    RPowerType:req.body.PowerType

                },
                { autoCommit: true },
                function(err, result) {
                    if (err) {
                        console.error(err.message);
                        doRelease(connection);
                        return;
                    }
                    res.json(result);
                    doRelease(connection);
```

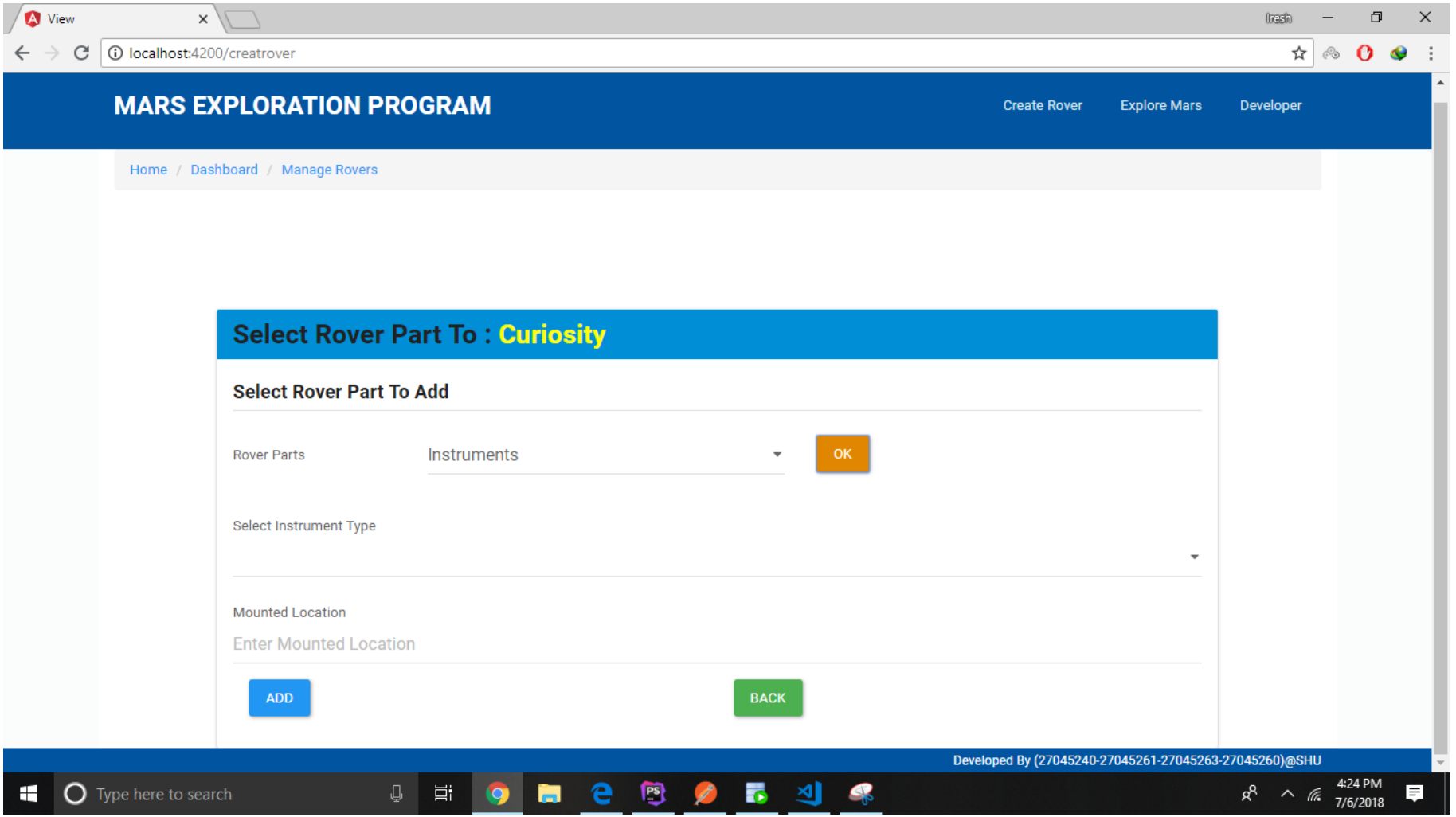
10. Test Result

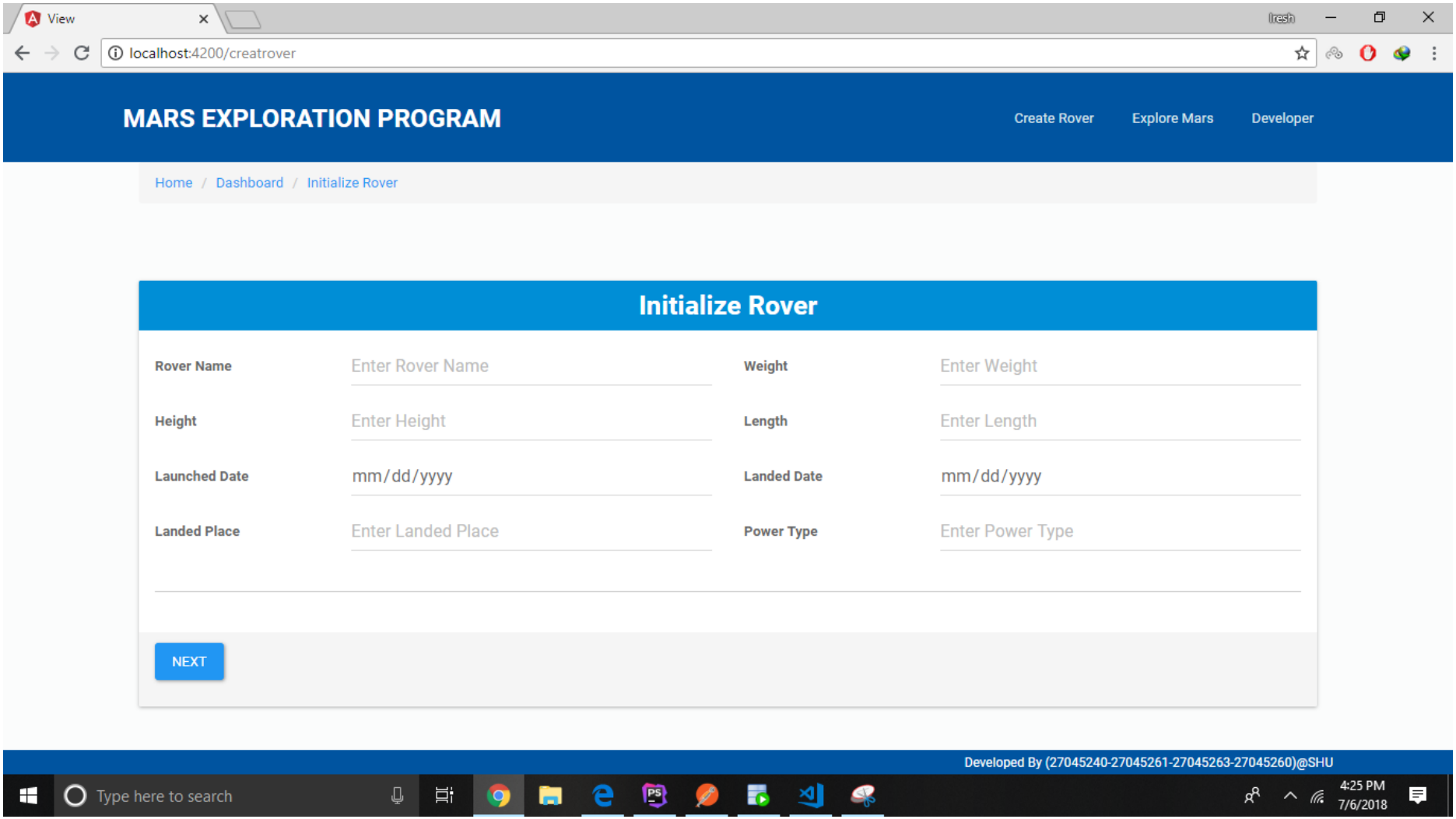


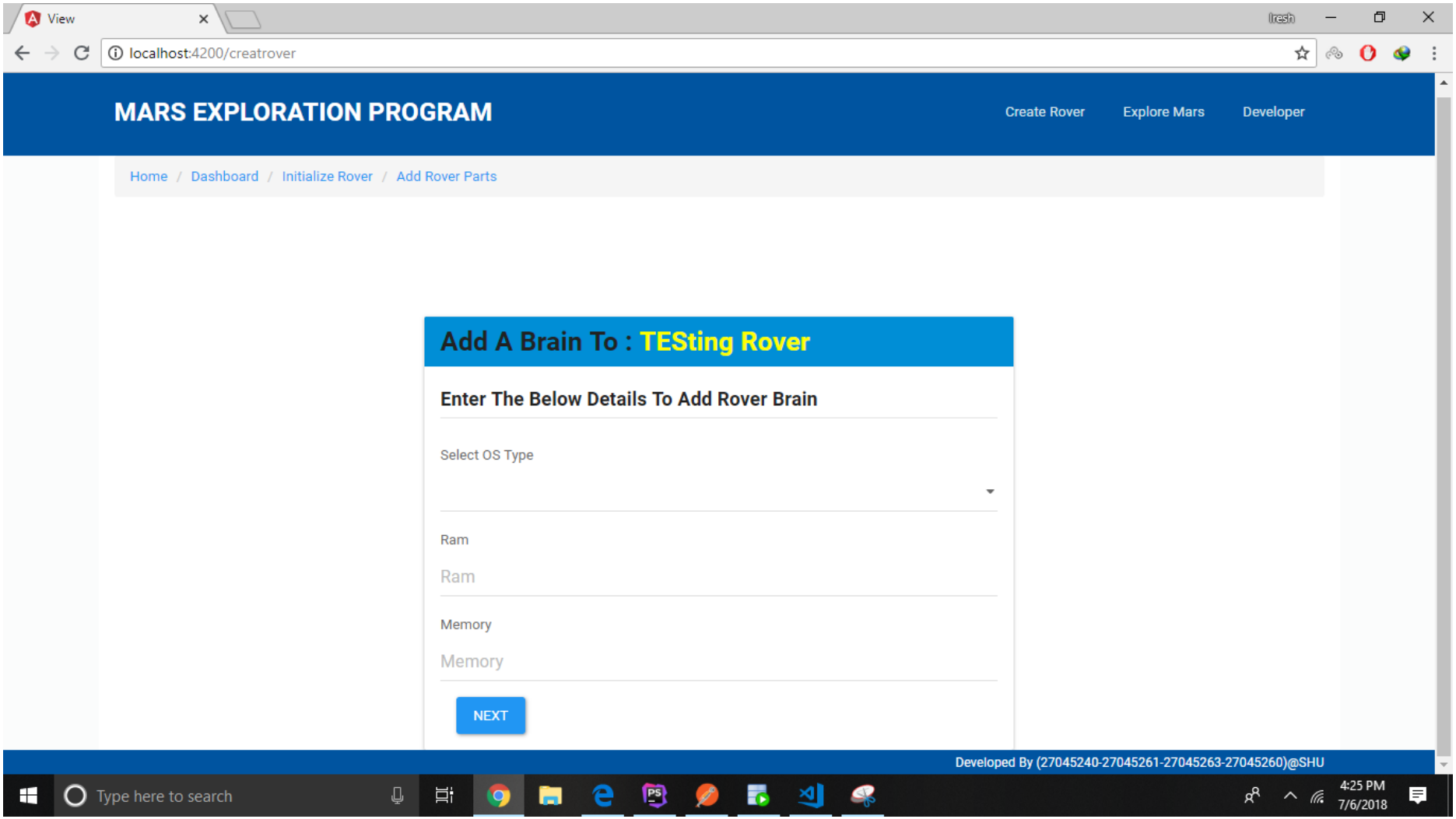

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard
WELCOME SCIENTIST
Please select an option to proceed
Setup a Rover
Manage Rovers
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:24 PM
7/6/2018

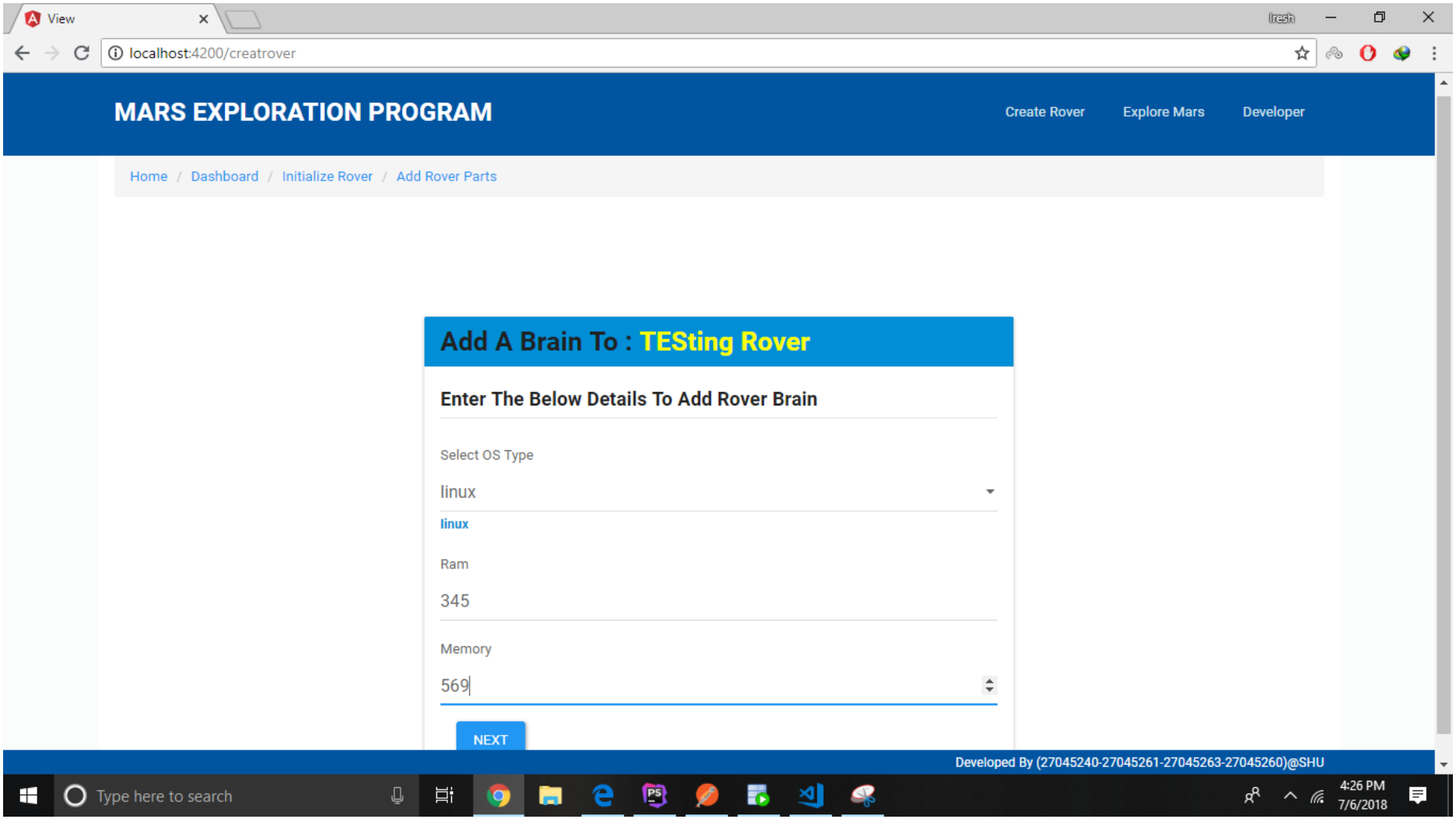

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard / Manage Rovers
Select a Rover
Below is the list of Rovers Added
Your Rovers
RID Name Height Weight Sensor Count Camera Count Instrument Count Actions
33 Curiosity 12 6 2 2 2 ADD NEW PARTS UPDATE ROVER DELETE ROVER
32 Opportunity 13 45 3 2 1 ADD NEW PARTS UPDATE ROVER DELETE ROVER
31 Spirit (MER-A) 10 7 2 2 2 ADD NEW PARTS UPDATE ROVER DELETE ROVER
30 Beagle 2, 8 9 3 2 2 ADD NEW PARTS UPDATE ROVER DELETE ROVER
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:24 PM
7/6/2018

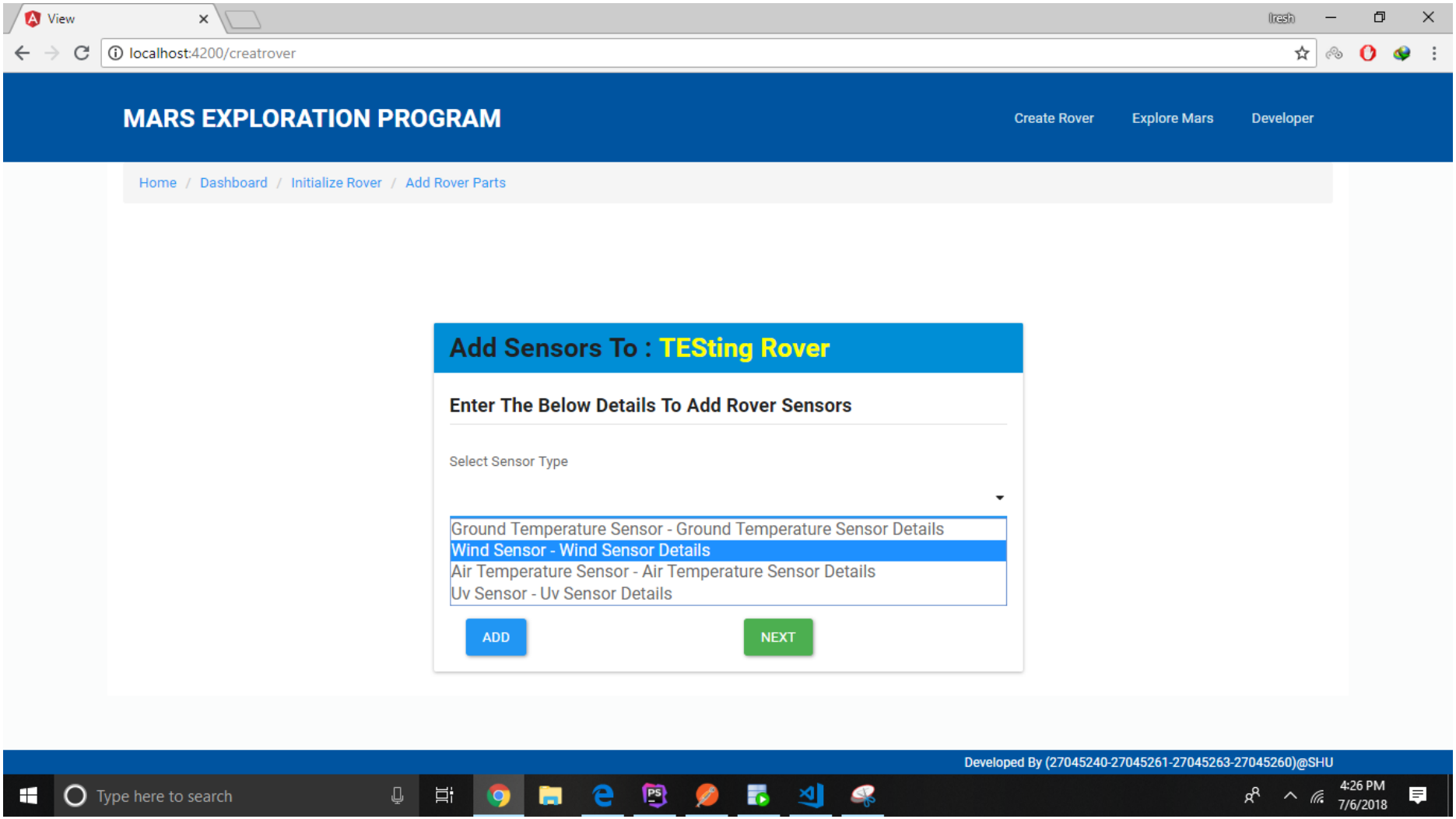

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard / Manage Rovers
Select Rover Part To : Curiosity
Select Rover Part To Add
Rover Parts
Cameras
OK
Select Camera Type
Mounted Location
Enter Mounted Location
ADD
BACK
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:24 PM
7/6/2018

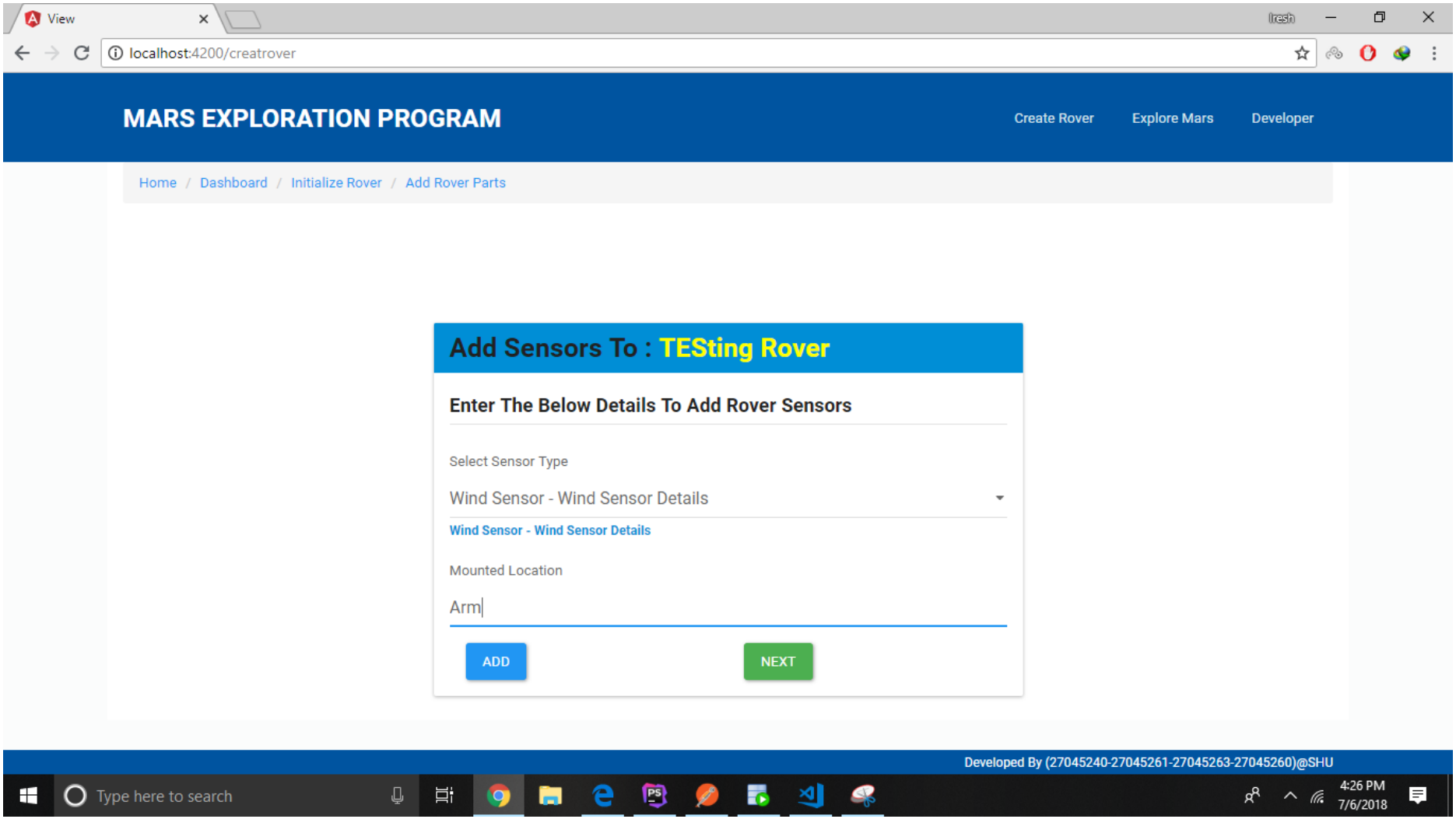

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard / Manage Rovers
Select Rover Part To : Curiosity
Select Rover Part To Add
Rover Parts
Instruments
OK
Select Instrument Type
Mounted Location
Enter Mounted Location
ADD
BACK
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:24 PM
7/6/2018

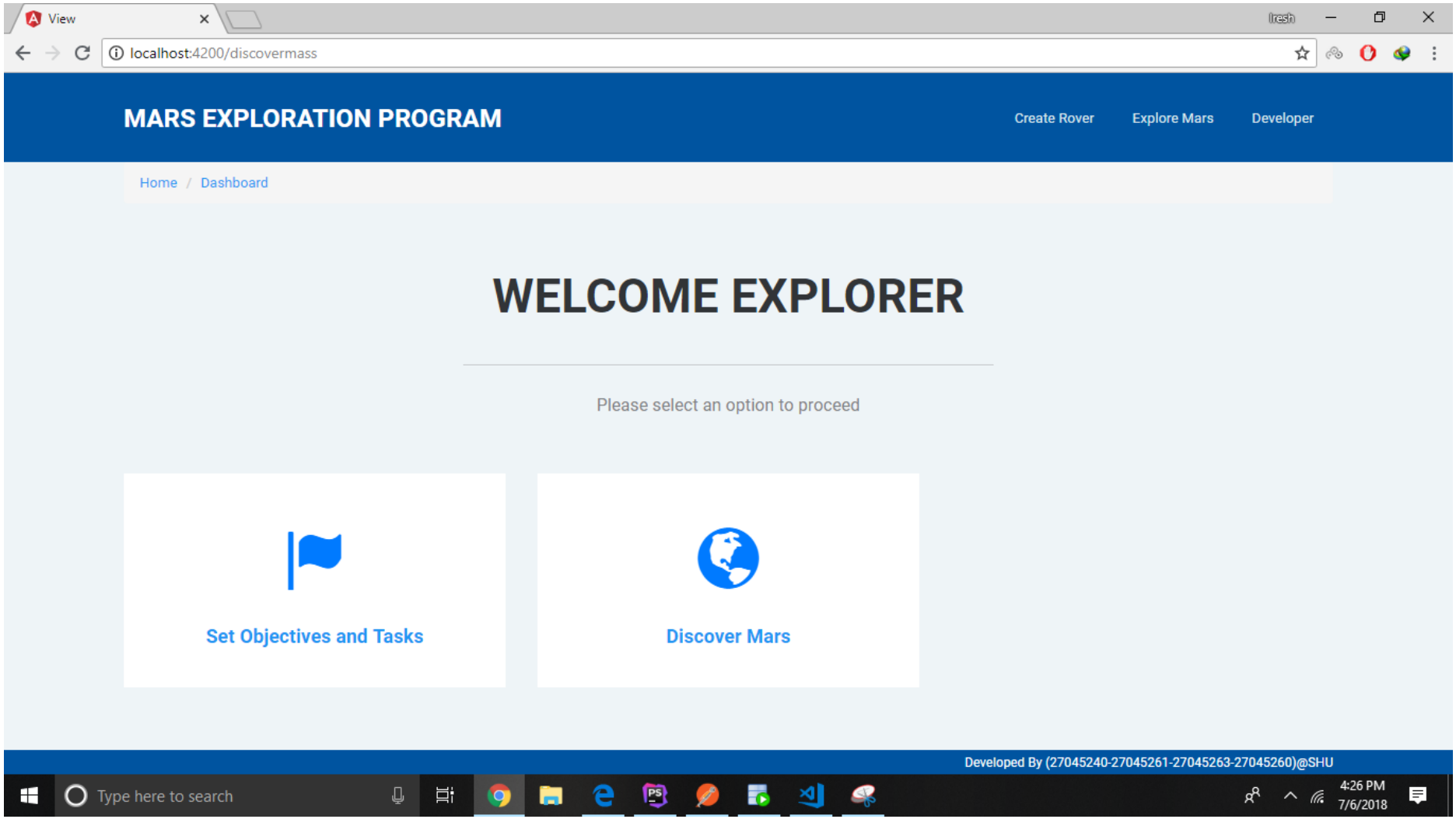

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard / Initialize Rover
Initialize Rover
Rover Name
Enter Rover Name
Weight
Enter Weight
Height
Enter Height
Length
Enter Length
Launched Date
mm/dd/yyyy
Landed Date
mm/dd/yyyy
Landed Place
Enter Landed Place
Power Type
Enter Power Type
NEXT
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:25 PM
7/6/2018

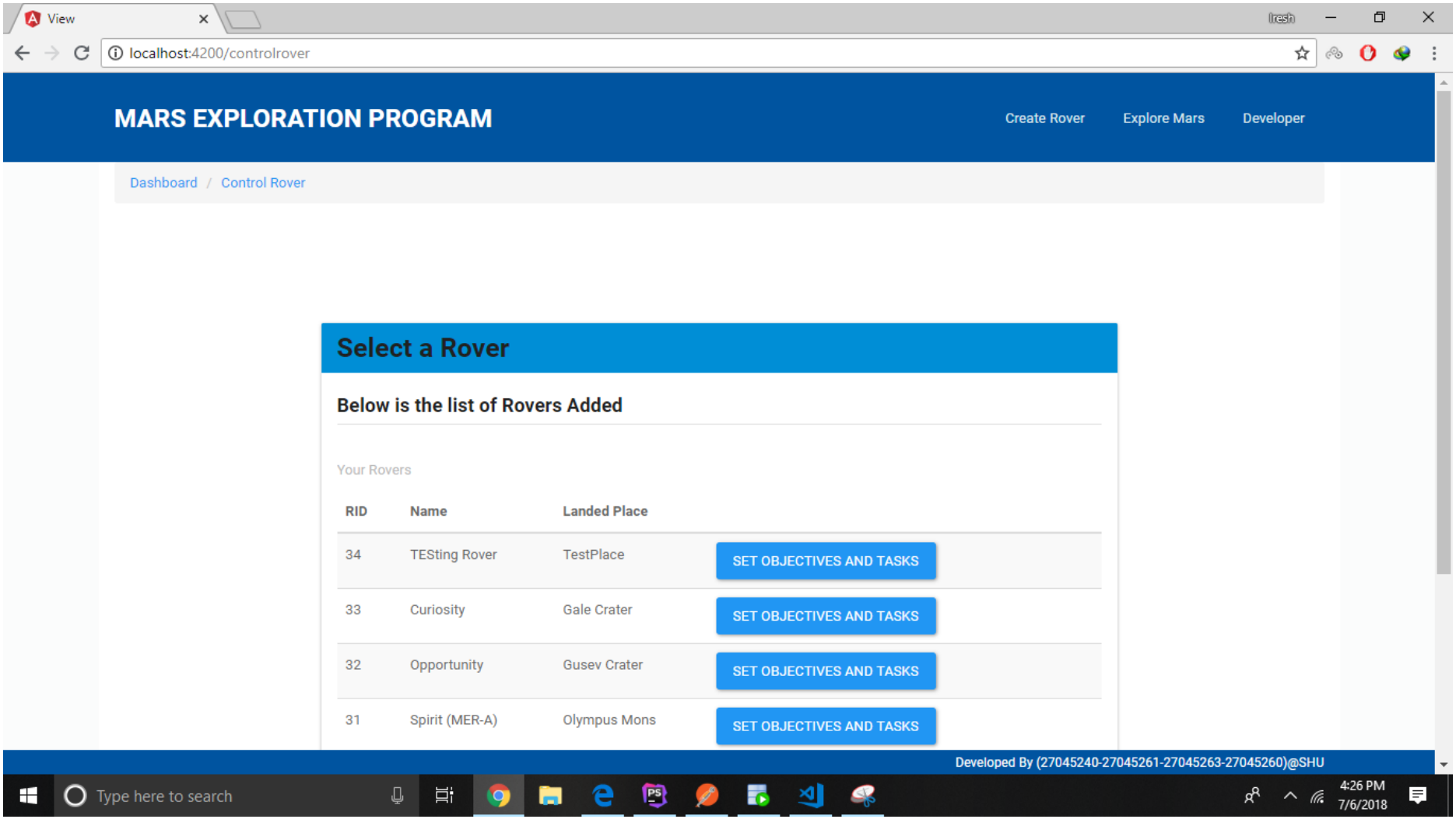

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard / Initialize Rover / Add Rover Parts
Add A Brain To : TESting Rover
Enter The Below Details To Add Rover Brain
Select OS Type
Ram
Ram
Memory
Memory
NEXT
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:25 PM
7/6/2018

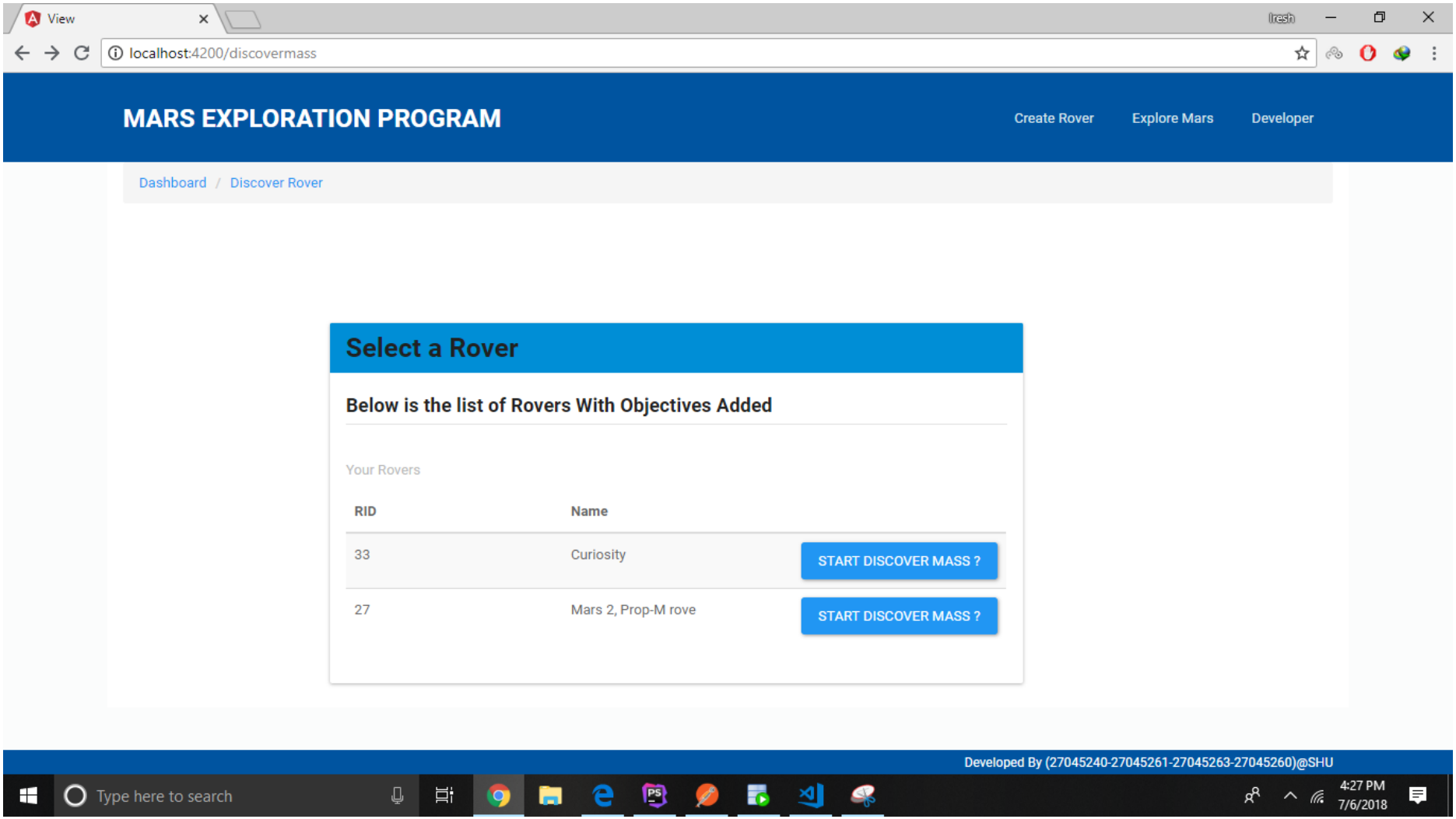

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard / Initialize Rover / Add Rover Parts
Add A Brain To : TESting Rover
Enter The Below Details To Add Rover Brain
Select OS Type
linux
linux
Ram
345
Memory
569
NEXT
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:26 PM
7/6/2018

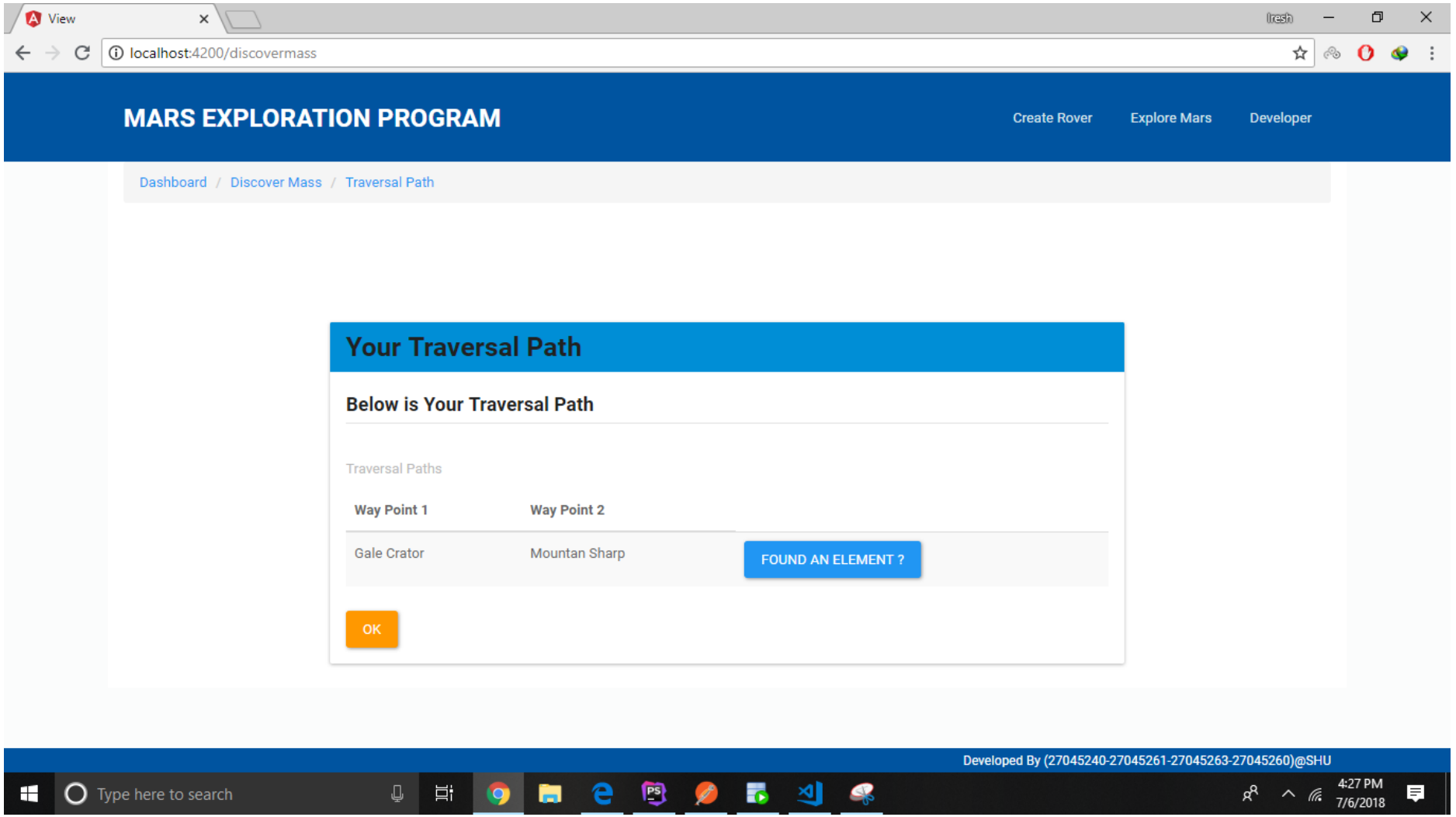

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard / Initialize Rover / Add Rover Parts
Add Sensors To : TESting Rover
Enter The Below Details To Add Rover Sensors
Select Sensor Type
Ground Temperature Sensor - Ground Temperature Sensor Details
Wind Sensor - Wind Sensor Details
Air Temperature Sensor - Air Temperature Sensor Details
Uv Sensor - Uv Sensor Details
ADD
NEXT
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:26 PM
7/6/2018

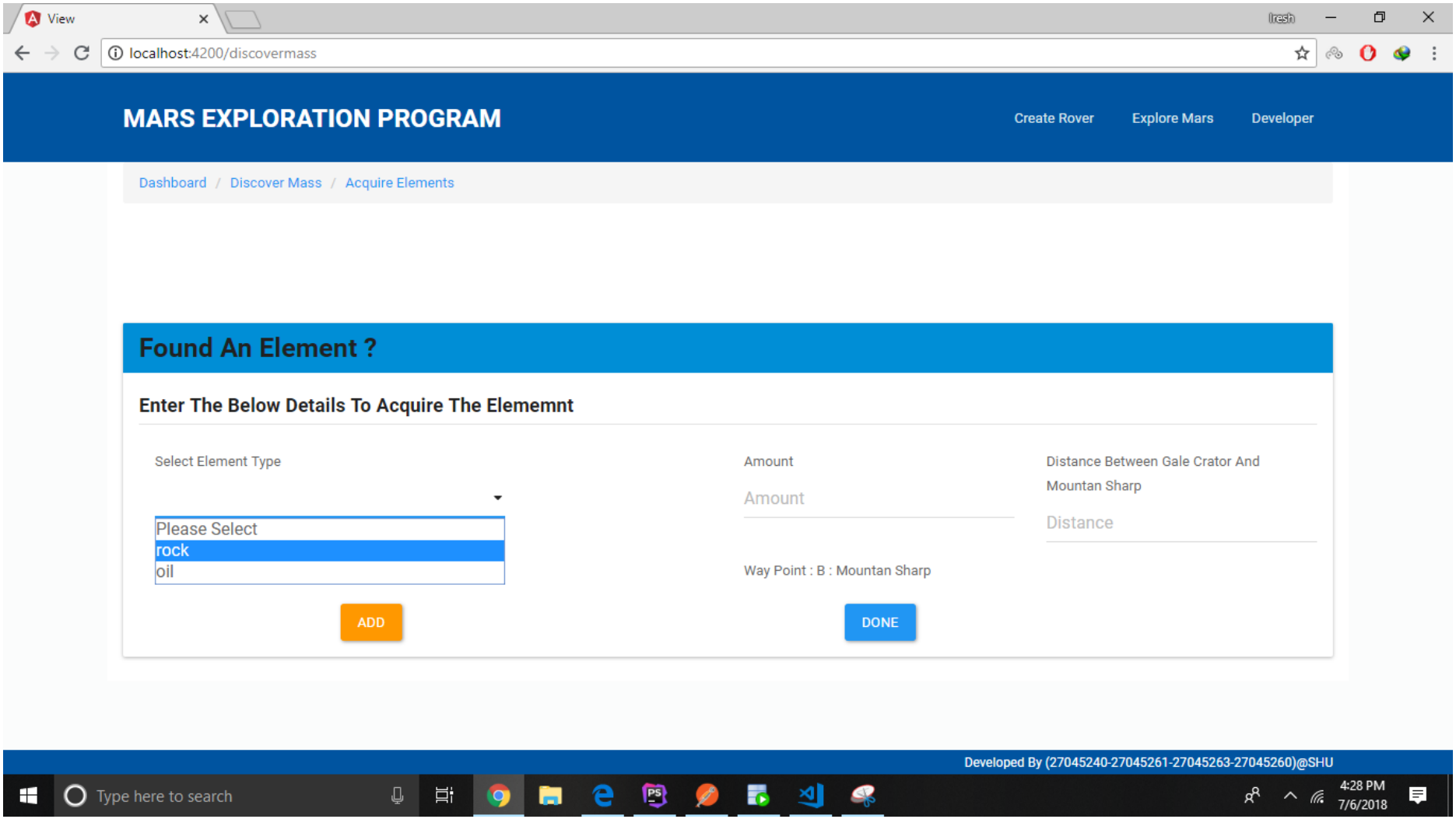

View
localhost:4200/creatrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard / Initialize Rover / Add Rover Parts
Add Sensors To : TESting Rover
Enter The Below Details To Add Rover Sensors
Select Sensor Type
Wind Sensor - Wind Sensor Details
Wind Sensor - Wind Sensor Details
Mounted Location
Arm
ADD
NEXT
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:26 PM
7/6/2018

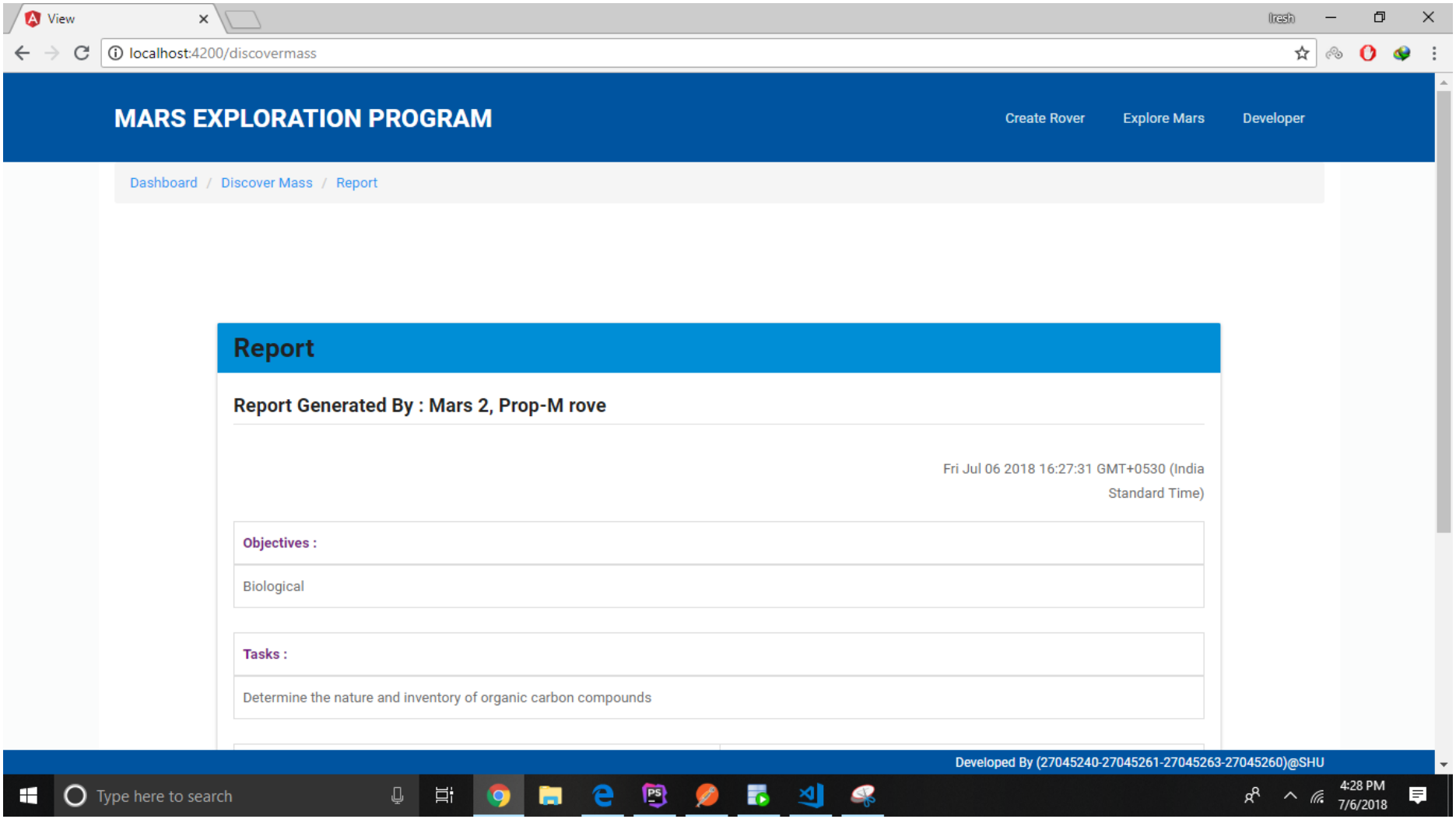

View
localhost:4200/discovermass
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard
WELCOME EXPLORER
Please select an option to proceed
Set Objectives and Tasks
Discover Mars
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:26 PM
7/6/2018

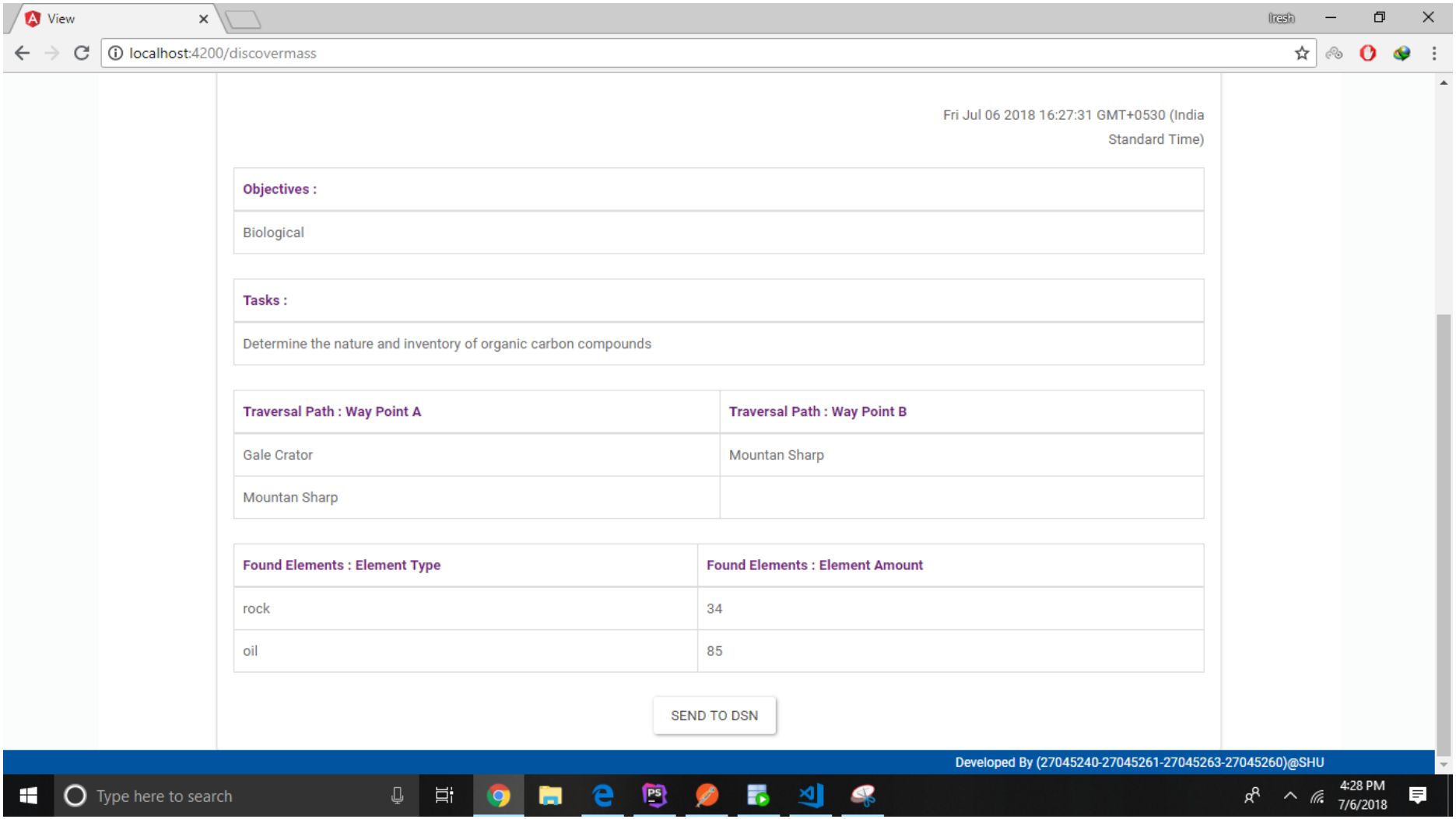

View
localhost:4200/controlrover
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Dashboard / Control Rover
Select a Rover
Below is the list of Rovers Added
Your Rovers
RID
Name
Landed Place
34
TESting Rover
TestPlace
SET OBJECTIVES AND TASKS
33
Curiosity
Gale Crater
SET OBJECTIVES AND TASKS
32
Opportunity
Gusev Crater
SET OBJECTIVES AND TASKS
31
Spirit (MER-A)
Olympus Mons
SET OBJECTIVES AND TASKS
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:26 PM
7/6/2018

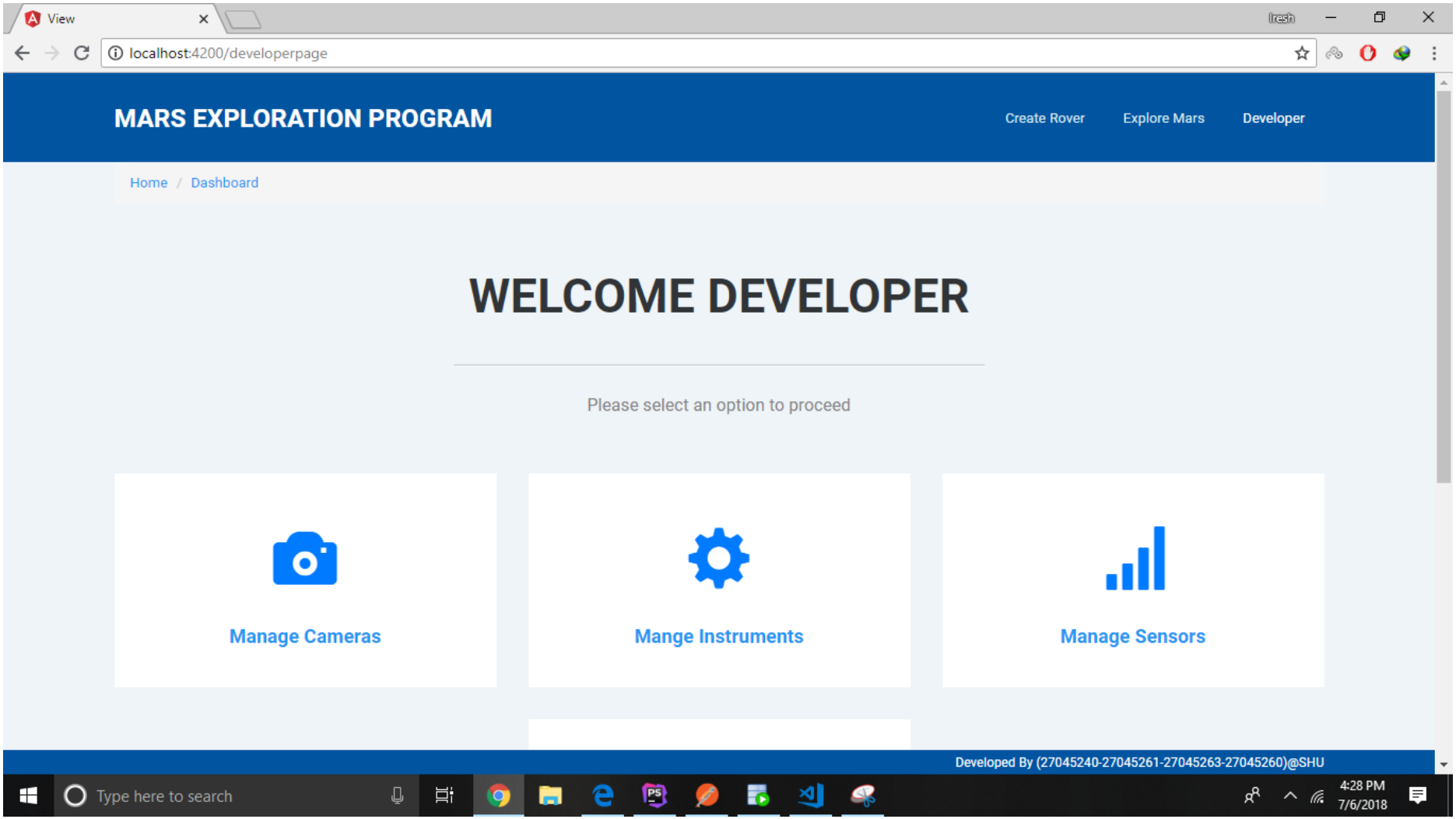

View
localhost:4200/discovermass
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Dashboard / Discover Rover
Select a Rover
Below is the list of Rovers With Objectives Added
Your Rovers
RID
Name
33
Curiosity
START DISCOVER MASS ?
27
Mars 2, Prop-M rove
START DISCOVER MASS ?
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:27 PM
7/6/2018

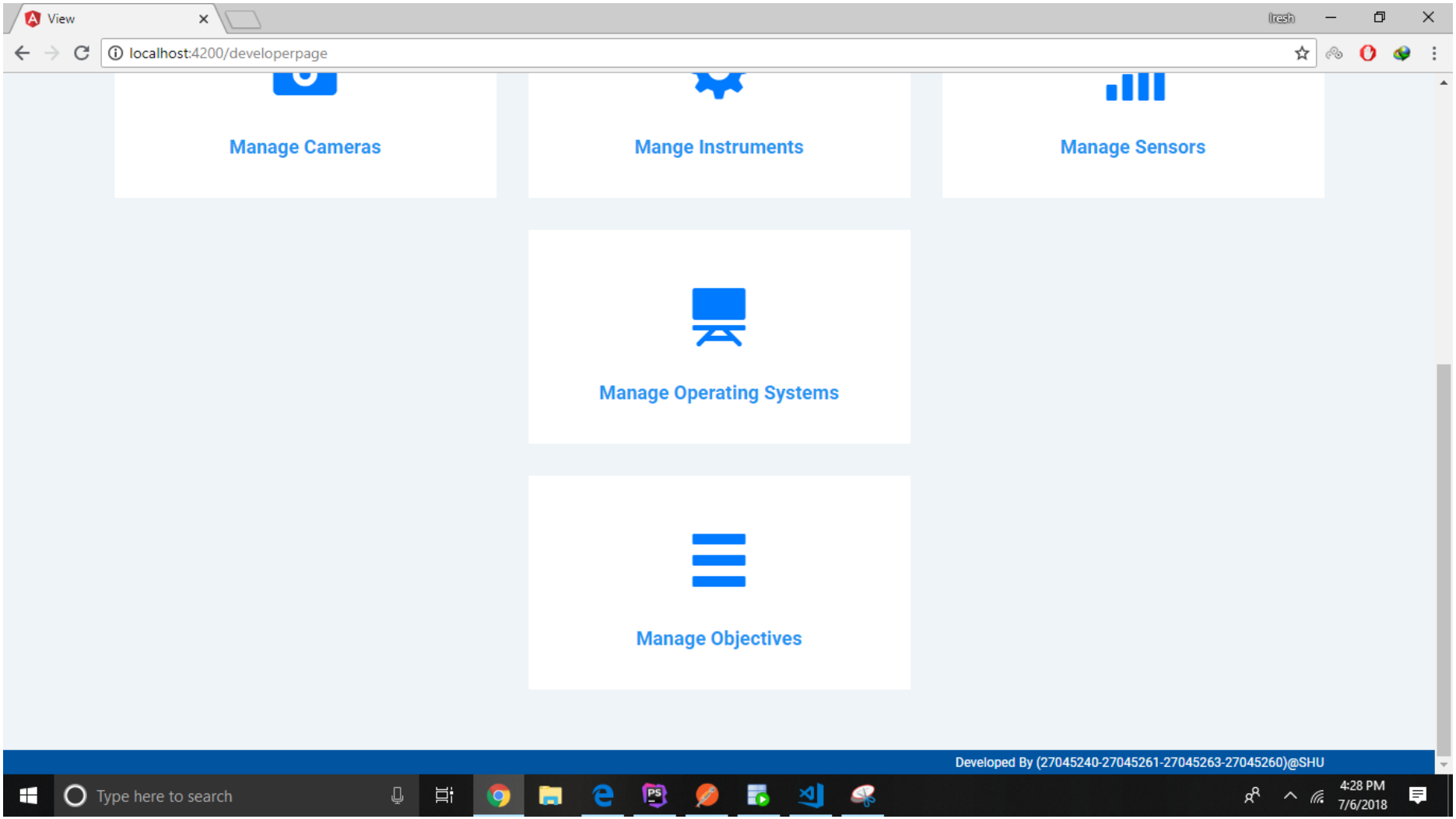

View
localhost:4200/discovermass
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Dashboard / Discover Mass / Traversal Path
Your Traversal Path
Below is Your Traversal Path
Traversal Paths
Way Point 1
Way Point 2
Gale Crator
Mountan Sharp
FOUND AN ELEMENT ?
OK
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:27 PM
7/6/2018


View
localhost:4200/discovermass
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Dashboard / Discover Mass / Acquire Elements
Found An Element ?
Enter The Below Details To Acquire The Elememnt
Select Element Type
Please Select
rock
oil
ADD
Amount
Amount
Way Point : B : Mountan Sharp
DONE
Distance Between Gale Crator And Mountan Sharp
Distance
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:28 PM
7/6/2018


View
localhost:4200/discovermass
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Dashboard / Discover Mass / Report
Report
Report Generated By : Mars 2, Prop-M rove
Fri Jul 06 2018 16:27:31 GMT+0530 (India Standard Time)
Objectives :
Biological
Tasks :
Determine the nature and inventory of organic carbon compounds
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:28 PM
7/6/2018


View
localhost:4200/discovermass
Fri Jul 06 2018 16:27:31 GMT+0530 (India Standard Time)
Objectives :
Biological
Tasks :
Determine the nature and inventory of organic carbon compounds
Traversal Path : Way Point A
Traversal Path : Way Point B
Gale Crator
Mountan Sharp
Mountan Sharp
Found Elements : Element Type
Found Elements : Element Amount
rock
34
oil
85
SEND TO DSN
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:28 PM
7/6/2018


View
localhost:4200/developerpage
MARS EXPLORATION PROGRAM
Create Rover
Explore Mars
Developer
Home / Dashboard
WELCOME DEVELOPER
Please select an option to proceed
Manage Cameras
Mange Instruments
Manage Sensors
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:28 PM
7/6/2018


View
localhost:4200/developerpage
Manage Cameras
Mange Instruments
Manage Sensors
Manage Operating Systems
Manage Objectives
Developed By (27045240-27045261-27045263-27045260)@SHU
Type here to search
4:28 PM
7/6/2018

10. References

[1]. node-oracledb. (2018). node-oracledb 2.3 Documentation for the Oracle Database Node.js Add-on. [online] Available at: https://oracle.github.io/node-oracledb/doc/api.html [Accessed 6 Jul. 2018].

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[5]. NASA. (2018). National Aeronautics and Space Administration. [online] Available at: https://www.nasa.gov/ [Accessed 6 Jul. 2018].

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