PONDICHERRY UNIVERSITY

(A Central university)
PUDUCHERRY

Master of Computer Applications – VI Semester

School of Engineering and Technology

Department of Computer Science

COMS 563: MAIN PROJECT

Project Title: **REAL-TIME ANDROID BASED INDOOR NAVIGATION SYSTEM**

Under the guidance of: **Submitted by:**

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1. <u>INTRODUCTION</u>

1.1   ABOUT THE PROJECT

In a large hospital consisting of several medical departments, it is difficult for the visitors to reach their destination smoothly. In particular, in the case of a medical examination, visitors often get mislead because they should visit many medical departments that are apart from each other. This causes a problem particularly for elderly people.

To solve this problem, a guidance system that can be used in hospitals is being developed. In the guidance system, the indoor position estimation is one of the most important technologies. Presently, GPS based navigation may be used. But GPS is not suitable for indoor navigation, as GPS coordinates cannot communicate with the satellite.

Using a Wi-Fi as one of the indoor positioning technologies has also been studied. In these studies, a user's position is estimated based on Received Signal Strength Indication (RSSI) of radio waves transmitted from Wi-Fi access points. However, Wi-Fi access points are not available within the hospitals because, the radio waves may affect operation of the medical equipments. And so, Bluetooth is used for indoor navigation, in this project.

In recent years, Android phones are equipped with Bluetooth. The User/Patient owns an Android Mobile, which is used to identify the current location and also helps to track the destination using Received Signal Strength Indication (RSSI). Based on the maximum strength value, the User's current location is identified. This proves that it is an easy way to map the user's current location with the requested destination.

2. <u>POBLEM DEFINITION</u>

2.1 EXISTING SYSTEM

The position estimation system using a GPS has become available with a wide spread of mobile devices equipped with GPS. However, the GPS can't be used in an indoor environment because; the GPS co-ordinates cannot communicate with the satellites as they are blocked by walls or ceilings.

As indoor positioning technologies, methods using radio waves transmitted from multiple transmitters have been researched and developed. In these systems, the radio waves signal strength of Wi-Fi may be used. However, these radio waves adopt high bandwidths, which may interfere with the medical equipments, and hence haven't been used in hospitals.

2.2 PROPOSED SYSTEM

The proposed system uses the RSSI of the Bluetooth Adaptor radio waves transmitted from the indoor base stations in order to estimate the user's position.

In general, the RSSI varies according to the distance between a transmitter and a receiver. Therefore, the system estimates the distance between each base station and the android device which the user has, by confirming the RSSI values.

And then, the system calculates the position of the android device from the estimated distance to the base stations and locations of them which are pre-registered in the android device.

The bandwidth of the Bluetooth adapters is less, when compared with the bandwidth of the existing indoor positioning estimation system.

3. <u>SYSTEM ANALYSIS</u>

3.1   REQUIREMENT ANALYSIS

The Requirement analysis is two categories. They are

3.1.1 FUNCTIONAL REQUIREMENTS
3.1.2 NON FUNCTIONAL REQUIREMENTS

3.1.1 FUNCTIONAL REQUIREMENTS

3.1.1.1   Android user

Develop an android application for the indoor navigation which is to be installed in the mobile. Here we consider the scenario of a hospital. The Mobile Client is the Android application which was created and installed in the User's Android mobile phone, so that we can perform the proposed actions. While creating the Android Application, we have to design the page by dragging the tools like Button, Text field, and Radio Button on to the layout window. Once we have designed the page, we have to write the codes for each. After creating the full mobile application, it will be generated as an Android Platform Kit (APK) file. This APK file will be installed in the User's Mobile Phone as an application.

3.1.1.2   Server

This is the Server Application which is used to communicate with the Mobile Clients. The Server can communicate with their Mobile Client by GPRS or Bluetooth Technology. In the Project we are using Bluetooth technology to access with the Client. The Server Application can be created using Java/ DotNet Programming Languages. The Server will monitor the Mobile Client's accessing information and Respond to Client's Requested Information. The Server will not allow the unauthorized users from entering into the network, so that we can prevent the network from illegitimate user's activities. The server will also identify the Malicious Nodes activities. Server will communicate with the android mobile user to deliver the map in a graph format.

3.1.1.3   Bluetooth Hardware Fabrication

Bluetooth is a wireless technology standard for exchanging data over short distances from fixed and mobile devices, creating a personal area networks (PANs) with high levels of security. It can connect several devices, overcoming the problems of synchronization. We have to set a Bluetooth tower in each department. For example, departments in a hospital may include the X-RAY, ECG, and Neurons departments, Labs, Ophthalmology department, Scan Department and the Doctor's cabin. A Bluetooth tower is set up in each of these departments by attaching a Bluetooth adaptor to each of the Servers.

Class Maximum	Range (m)
Class 1	~100
Class 2	~10
Class 3	~1

3.1.1.4   Mapping System

The server will calculate the received signal strength by identifying the maximum signal in a particular area.

3.1.2 NON FUNCTIONAL REQUIREMENTS

The principal non functional constraints which are relevant to critical systems are:

- ➢ Security
- ➢ Reliability
- ➢ Performance
- ➢ Safety
- ➢ Usability
- ➢ Maintainability
- ➢ Portability
- ➢ Extensibility

3.1.2.1 Security

Security requirements are included in a system to ensure:

- Unauthorized access to the system and its data

- Ensure the integrity of the system from accidental or malicious damage.

3.1.2.2 Reliability

Reliability is the ability of the system to perform its required functions under stated conditions for a specific period of time. It depends on the run-time behavior of the system.

3.1.2.3 Performance

Performance requirements concern the speed of operation of the system. Performance requirements ore of 3 types:

- o Response requirements
- o Throughput requirements
- o Availability requirements
- o

3.1.2.4 Safety

There is no consensus in the system's engineering community about what is meant by the term 'safety requirement'. Usage of the term often depends on the culture and practice of the organization.

3.1.2.5   Usability

Usability is the ease with which a user can learn to operate, prepare inputs for, and interpret outputs of system or component.

Usability requirements include:

- o   Well-structured user manuals
- o   Informative error messages
- o   Help facilities
- o   Well-formed Graphical User Interfaces(GUIs)

3.1.2.6   Maintainability

Maintainability is the modification of a software product after delivery to correct faults, to improve performance or other attributes.

3.1.2.7   Portability

Portability is the usability of the same software in different environments. The pre requirement for portability is the generalized abstraction between the application logic and system interfaces. When software with the same functionalities is produced for several computing platforms, portability is the key issue for development cost reduction.

3.1.2.8   Extensibility

Extensibility is a system design principle where the implementation takes future growth into consideration. It is a systemic measure of the ability to extend a system and the level of effort required to implement the extension.

3.2 FEASIBILITY ANALYSIS

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some of the understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

1.   ECONOMIC FEASIBILITY
2.   BEHAVIORAL FEASIBILITY
3.   TECHNICAL FEASIBILITY

3.2.1 ECONOMIC FEASIBILITY

The study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system must be within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

3.2.2 BEHAVIORAL FEASIBILITY

People are inherently resisted to change and computers have been known to facilitate change. Since the new proposed system is nothing to do with the ordinary customers and worker resistance to the system are accessing this system through Internet and they are computer literate, so resistance from that side is also very less.

3.2.3 TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.
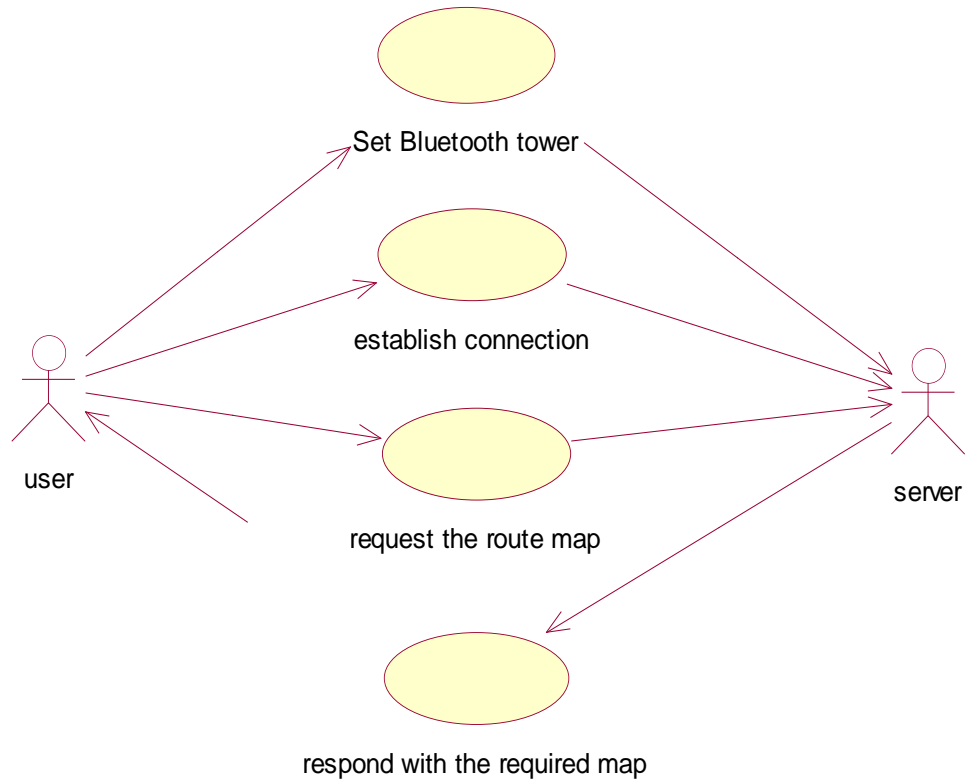
3.2.3.1   HARDWARE REQUIREMENTS

Processor   : Intel Core 2 Duo processor (2.2 GHz)

Hard disk   : 120 GB

RAM   : 2 GB DDR

Bluetooth

3.2.3.2   SOFTWARE REQUIREMENTS

Platform   : Windows XP
Front End   : Java JDK1.5.
IDE   : Eclipse
ANDROID

3.3   USE CASE DIAGRAM

Set Bluetooth tower

establish connection

user

request the route map

server

respond with the required map

4. <u>SYSTEM DESIGN</u>

System design is the process of planning the software product. The design acts as a link between the actual program specification and the actual implementation of the system. After the thorough analysis of the system, design of the system is carried out.

Design is essentially the bridge between requirements specification and the final solution for satisfying the requirements. The system design identifies the input and output that are involved in the system.

Properties of the system design are

- o Verifiability
- o Completeness
- o Consistency
- o Efficiency
- o Traceability
- o Simplicity/Understandability

The equipments needed to implement the new system is chosen while designing it as aimed to remove all the drawbacks and shortcomings of the existing system.

4.1 ARCHITECTURE DESIGN

It is concerned with refining the conceptual view of the system, identifying processing functions, defining internal data streams and data stores. It establishes relationships and interconnections among modules. Here a conceptual layout of the data structure and the databases are looked in more detail. The important inputs and outputs along with the functions to be provided are defined in this phase. The parts of the proposed system that are to be automated are clearly designed.

4.2 ACTIVITY DIAGRAM

tooth

h
n

respond with the
required map
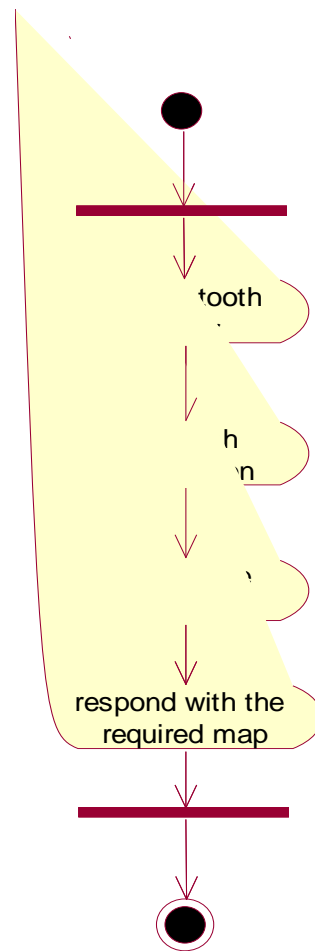
4.3   INTERFACE DESIGN

4.3.1 MAIN PAGE

```
┌──────────────────────────────────┐
│ Indoor Navigation                │
│ ┌──────────────────────────────┐ │
│ │ List View                    │ │
│ │                              │ │
│ │                              │ │
│ │                              │ │
│ │                              │ │
│ │                              │ │
│ │                              │ │
│ │                              │ │
│ │                              │ │
│ └──────────────────────────────┘ │
│ ┌────────────────────┐ ┌───────┐ │
│ │                    │ │ Send  │ │
│ └────────────────────┘ └───────┘ │
└──────────────────────────────────┘
```

4.3.2 CUSTOM TITLE

```
┌──────────────────────────────────┐
│ Indoor Navigation                │
│ ┌─────┬──────────────┬─────────┐ │
│ │Text-│              │ Text-   │ │
│ │View │              │ View    │ │
│ │     │              │         │ │
│ │     │              │         │ │
│ │     │              │         │ │
│ │     │              │         │ │
│ │     │              │         │ │
│ │     │              │         │ │
│ │     │              │         │ │
│ │     │              │         │ │
│ └─────┴──────────────┴─────────┘ │
└──────────────────────────────────┘
```

4.3.3 DEVICE LIST

Indoor Navigation
Paired Devices (List View)
New Devices (List View)
Scan for new Devices

4.3.4 ECG DEPARTMENT

Indoor Navigation
Image View
Back

4.3.5 X-RAY DEPARTMENT

Indoor Navigation
Image View
Back

4.3.6 NEURO DEPARTMENT

Indoor Navigation
Image View
Back

5.   SYSTEM IMPLEMENTATION

5.1 IMPLEMENTATION

Implementation of the software refers to the final use of the package in real environment, to the satisfaction of the intended users and the operations of the system. The implementation phase of the software development is concerned with translating the design specification into the source code. Using structured coding techniques and good coding style enhances clarity of the source code. Codes for handling and providing validation have been introduced whenever necessary.

Implementation is a vital step in ensuring the success of new system. Even a well designed system can fail if it is not a properly implemented. Implementation activities are needed to transform a newly developed information system into an operational system for the end users.

5.2 IMPLEMENTATION OF THE REQUIREMENTS

This system is categorized into two different roles. One is the server side, and other one is the client side.

5.2.1 SERVER SIDE

The server side system is developed using Java. The central server has to be active in order to establish the connection with the client which request for one. The system can be run on Windows 7 environment. The recent versions of OS are required because a Bluetooth tower has to be set up in every department which is available only with the latest software. The server side programming requires Blue cove 2.0 which has to be installed in the server system.

5.2.1.1 IMPLEMENTATION OF BLUECOVE

BlueCove is a JSR-82 J2SE implementation that currently interfaces with the Mac OS X, WIDCOMM, BlueSoleil and Microsoft Bluetooth stack found in Windows XP SP2 and newer. It was originally developed by Intel Research and currently maintained by volunteers.

BlueCove runs on any JVM starting from version 1.1 or newer on Windows Mobile, Windows XP and Windows Vista, Mac OS X. Since version 2.1 BlueCove distributed under the Apache Software License, Version 2.0, and BlueCove provides Java API for Bluetooth JSR 82.
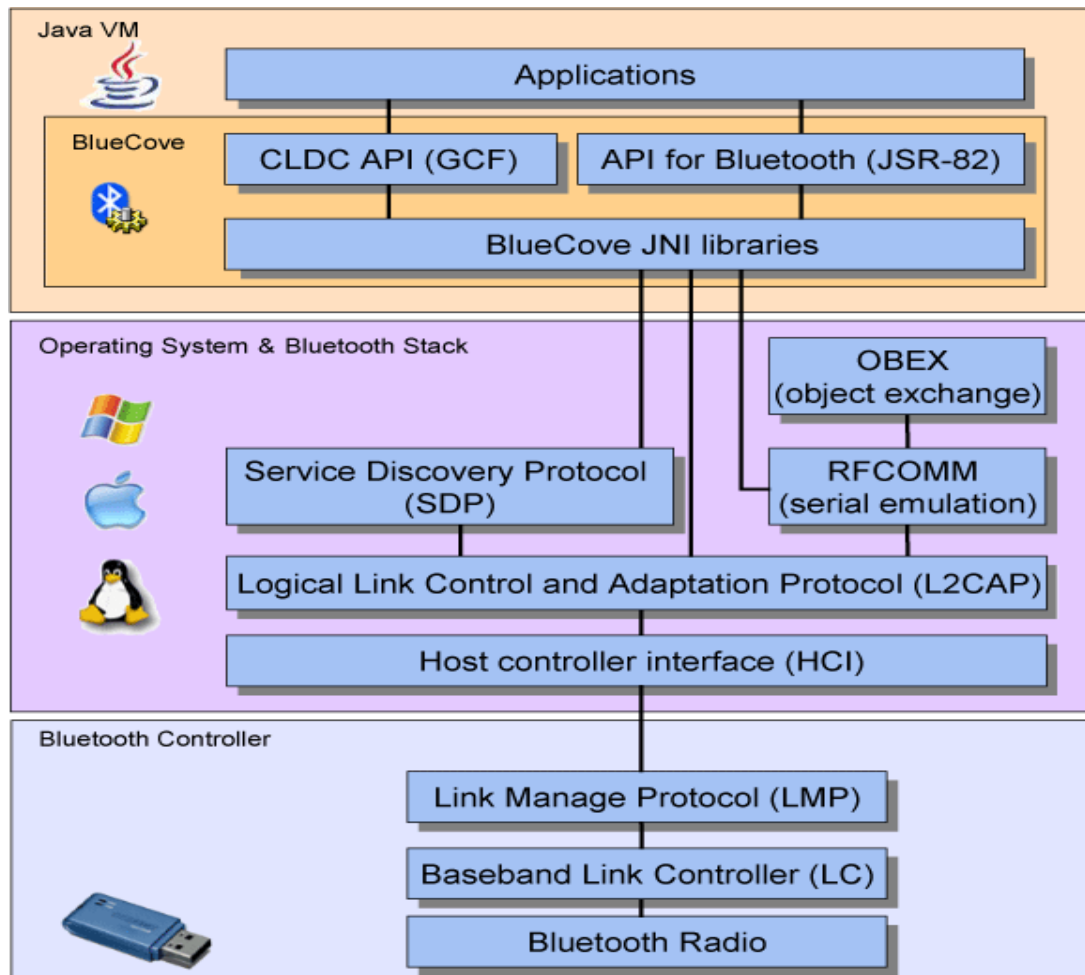
5.2.2 CLIENT SIDE

The client side is the Android mobile phone which the user owns. An android application is developed in Eclipse SDK. After completing the complete coding, an APK file which is generated is installed into the user's android mobile. This APK file is the application which serves the users to navigate indoors. The current location of the user is calculated from the RSSI (Receive Signal Strength Indication) values of the Bluetooth adaptors and Dead-Reckoning based on the sensors on the Android device.

5.2.2.1 DEAD-RECKONING

Dead-Reckoning is a method of estimating the user's position based on the sensor data obtained from various sensors such as an accelerometer and a gyroscope. In Dead-Reckoning, the position change is estimated by detecting movements and directions of the user from the sensor data.

The proposed system uses a combination of RSSI of the Bluetooth Adaptors and Dead-Reckoning to estimate the location of the user. Dead-Reckoning of the proposed system is carried out in the following ways.

- ❖ The number of steps during a walking is detected by the acceleration sensor
- ❖ A moving distance is calculated by multiplying the number of steps and the user's stride which is registered in advance
- ❖ A moving direction at a corner is estimated using gyroscope sensor or compass sensor values

5.3 SEQUENCE DIAGRAM
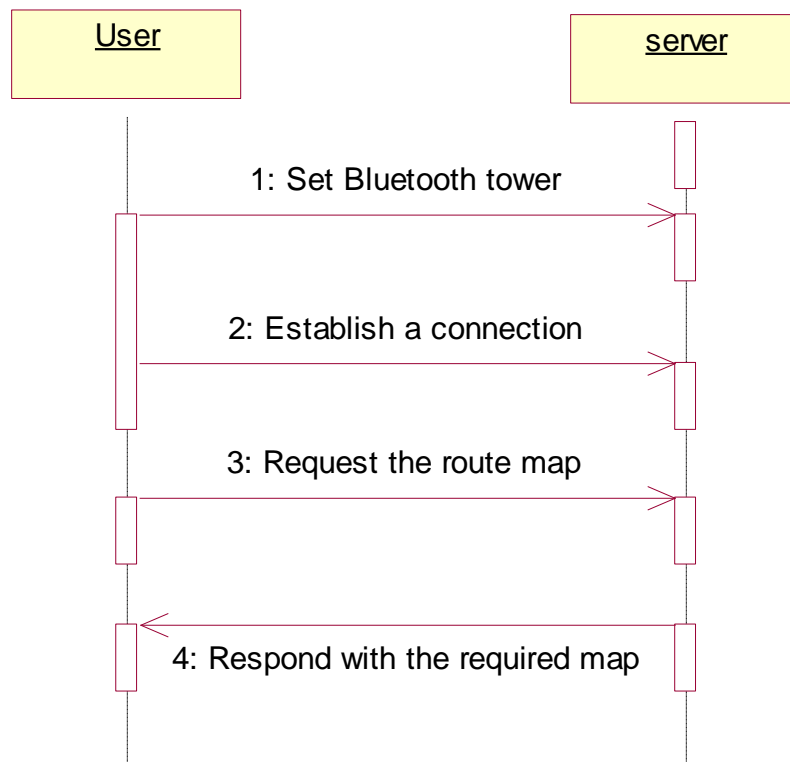
5.4 COLLABORATION DIAGRAM
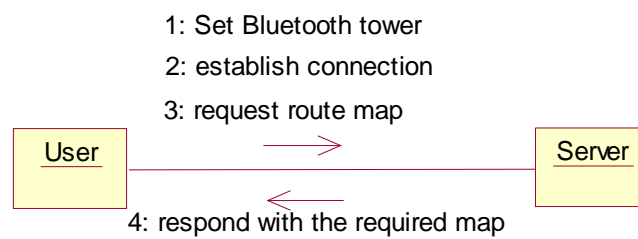
6. <u>CODING</u>

7. <u>SYSTEM TESTING</u>

7.1   TESTING OBJECTIVE

Software testing is an important phase in the development of the system. Generally, system testing involves testing integration of each module in the system. The objective while testing the system is to test the discrepancies between the system and the original objective.   The quality of an information system depends on its design, development and implementation.

Testing is the most important activity in the development phase.   Testing is the process of finding errors or bugs in the system.   Testing ensure that the user's needs are satisfied.   In other words it is a process by which one detects the defects in the system.

- ✓ Unit testing
- ✓ Integration testing
- ✓ User Interface Testing
- ✓ Functional Testing
- ✓ System Testing

7.2   UNIT TESTING

The candidate system is subjected to this test and the results are verified. Unit testing focuses on testing the individual modules developed. Each module is checked for its consistency. Data validating is done to avoid incorrect flow of data within the system.

Execution time and the response time for each module were checked and they were found to be a few seconds. The modules were also checked by giving some unexpected values for which the appropriate error messages were displayed and such entries were not accepted by the application.

Categories of unit testing:

- ➢ Black box testing
- ➢ White box testing

7.2.1 BLACK BOX TESTING

Black box testing consists of the following tests.

7.2.1.1 FUNCTIONAL TESTING

Functional test cases involves exercising the code with normal with values for which the expected results are known as well as boundary values and special values such as logically related inputs.

In this project this test can be performed using the validation such as content, range, compare valuators. For example we are doing the date format validation in the department and employee registration form. Range valuators are used to give all the inputs correctly before we save them with database.

7.2.1.2 PERFORMANCE TESTING

Performance testing determines the amount of execution time spent various parts of the unit, program throughput, and response time and device utilization by the program unit. Performance testing is most productive at the subsystem and system and system levels.

7.2.1.3 STRESS TESTING

Stress tests are those tests that can be designed to intentionally break the unit Stress test in the project can be performed by giving the breakpoints at a particular place Execution is stopped until it reaches the breakpoint. Thus we need not execute the whole module or entire project.

7.2.2 WHITE BOX TESTNG

      White box testing is otherwise called as structure test. The structure tests are concerned with the exercising the internal logic of program and traversing particular execution paths.

      This test can be made by testing a entire module. The module may contain several forms. These forms are executed and their control structures are also tested for their proper execution.

7.3   INTEGRATION TESTING

The testing operation conducted after combining all the subsystem modules to check for the correctness of the output is integration testing. Even though a module of unit testing performed successful, it is necessary to check the integration, since the integration links may lead to erroneous results. This test is done using test cases and the results are proved to be consistent.

➢ This may be carried out in 2 ways. They are

7.3.1 BOTTOM UP INTEGRATION

Bottom-up integration consists of unit testing by subsystem testing. Followed by testing of the entire system.Instead of testing from the first module this project uses the bottom-up strategy for testing. First we can check with an individual form and we can test that module and with the entire project involves that particular project.

7.3.2 TOP-DOWN INTEGRATION

Top-down integration starts with the main routine and one or two immediately subroutines in the system structure. We can test our project starting from the main form.

7.4   ACCEPTANCE TESTING

Acceptance testing is carried out to determine how far the user's requirements and needs are satisfied. The actual user tested integrated and tested modules. Some customized queries and the users of the system suggested reports. All the suggestions given by the users were considered and incorporated.

8. SAMPLE SCREENSHOTS

9. CONCLUSION AND FUTURE ENHANCEMENTS

9.1 CONCLUSION

In this project, RSSI algorithm and Auto Scanning Bluetooth are used. By installing the Bluetooth hardware at every location inside a building, we can get the location map of every department and this helps indoor navigation easier.

9.2 FUTURE ENHANCEMENTS