



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DEVELOPMENT OF MOBILE ROBOT CONTROL BY  
ANDROID VIA BLUETOOTH**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's of Electrical Engineering Technology (Industrial Automation and Robotic) with Honours

by

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## DECLARATION

I hereby, declared this report entitled “Development of Mobile Robot Control by Android via Bluetooth” is the results of my own research except as cited in references.

Signature : .....

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Date : 29/5/2015

## **APPROVAL**

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the Bachelor's of Electrical Engineering Technology (Industrial Automation and Robotic) with Honours. The member of the supervisory is as follow:

.....  
(MR MOHD ZAIDI BIM MOHD TUMARI)

## ABSTRACT

Today, robot development is famously talking about. In addition to the creation of robots are increasingly developing at present, it can help lighten the load carried by humans. Before the creation of the robot, people used to do physical work. This will cause harm to human and increase the risk of the occurrence of an accident. So to solve this problem, a robot designed to ease the work of human. Same as the purpose of the robot development, the mobile robot development is design to help human and increase the human interaction between human and robot. The mobile robot can be control wirelessly through the connection between Android mobile phone and the brain of the mobile robot that is Arduino UNO via Bluetooth. The robot also can avoid obstacle and avoid a barrier that get in the way of the robot. In mechanical part, Solidwork is important software to design the hardware of the robot, especially for the body of mobile robot. In electrical part, DC motor is use to drive the robot, Ultrasonic sensor is to manage the obstacle avoidance and Bluetooth is use to connect between the robot and the controller.

## ABSTRAK

Hari ini, penciptaan robot amat pesat membangun. Disamping penciptaan robot semakin membangun pada masa ini, ia dapat membantu meringankan beban yang ditanggung oleh manusia. Sebelum penciptaan robot, manusia menggunakan fizikal untuk bekerja. Ini akan menyebabkan kemudaratan kepada manusia dan meningkatkan risiko berlakunya kemalangan. Jadi untuk menyelesaikan masalah ini, robot dicipta untuk memudahkan kerja-kerja manusia. Sama seperti tujuan pembangunan robot, pembangunan robot mudah alih adalah satu ciptaan untuk membantu manusia dan meningkatkan interaksi di antara manusia dan robot. Robot mudah alih dikawal dengan tidak menggunakan wayar, tetapi menggunakan Android melalui Bluetooth. Robot ini juga boleh mengelakkan halangan yang menghalang pergerakan robot. Dalam bahagian mekanikal, Solidwork adalah perisian penting untuk mereka bentuk perkakasan robot, terutama bagi bahagian badan robot. Dalam bahagian elektrik, DC motor digunakan untuk memandu robot, sensor ultrasonik adalah untuk menguruskan aktiviti mengelakkan halangan dan Bluetooth adalah digunakan untuk menyambung antara robot dan pengawal. Arduino Uno adalah digunakan sebagai otak robot.

## **DEDICATION**

To my beloved parents

To my kind lecturers

And not forgetting to all friends

For their

Love, Sacrifice, Encouragement, and Best Wishes

## **ACKNOWLEDGEMENT**

In order to complete this project, I have received many help from my supervisors, lecturers, researchers and family members and also dearest friend.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Project Background

With each passing day the gap between robot and human being reduced by the introduction of new technologies for reduce living standards. Communication devices such as mobile phones with the latest android system are increasingly widespread its use in the community. So it is a disadvantage in society if the growing technology is not used for public purposes. The development of mobile robot control with Android via Bluetooth is a project or system to facilitate human interaction with machines while displaying a new dimension in the field of robot control.

This project uses Arduino board that can be programmed to give instructions to the robot to be controlled. The Arduino Uno is a microcontroller board based on the ATmega328. Arduino board is a new tool that is easier to be lifted to give instructions to a machine or to an electronic device to be controlled. This Arduino board use in this project is to give direction or control of mobile robots more easily, as well as it is easier to be programmed using software.

Bluetooth module also used to connect between the mobile robot and the mobile android telephone. Bluetooth is standard for the short-range wireless interconnection of mobile phones, computers, and other electronic devices. The used of Bluetooth in this project is to connect the mobile robot with an Android system used in hand phone wirelessly beside easier for user to control the mobile robot. DC motor with driver that powered by Lipo battery is used to drive the mobile robot (forward, backward, left and right) and Ultrasonic sensors is used as obstacle avoidance. Ultrasonic sensors use sound waves rather than light, making it ideal for stable detection of uneven surfaces, liquids, clear objects, and objects in dirty environments. These sensors work well for applications that require precise

measurements between stationary and moving objects. In this project, Ultrasonic sensors used to monitor the distance between the mobile robot and the barrier that blocking the mobile robot way. Besides, the mobile robot is able to avoid obstacle. The Android application is develop by using the MIT Application Inventor software. The application can communicate with the robot via Bluetooth and can be control wirelessly.

## **1.2 Problem Statement**

Today, the use of mobile phones with Android system is increasingly widespread use. It will be a loss if the system is not used for human benefit. The old mobile robot control is limited to control in a certain range. So the development of this mobile robot is to increase the range of control for the user. The disability to avoid obstacles of the old mobile robot could cause damage for the robot. In other word would say that will increase maintenance of the robot. The development of this mobile robot with ultrasonic sensor is expected to avoid obstacles while decreasing the maintenance cost for the user. The old mobile robot use wire to connect with controller which will give difficulties for user to control. This mobile robot is develop to control wirelessly via Bluetooth which will make user to control with less difficulties when using this robot.

## **1.3 Objectives**

- i. To develop a mobile robot that able to control by Android via Bluetooth.
- ii. To develop a mobile robot with Ultrasonic sensor that able to avoid obstacle.
- iii. To design mechanical structure, electronic circuit and control of the robot system.

#### **1.4 Work Scope**

- i. Mechanical design: for upon mechanical design requires several components, including body, tires and some other important components. This project used Perspex as its base or body.
- ii. Electronics design: this project used Arduino board to be program and give instruction to the mobile robot. DC motor is used to make the mobile robot moves while Bluetooth module needed to connect the mobile robot to be control by Android application.
- iii. Software design: This mobile robot software design used Arduino IDE to program the Arduino board and also used the MIT Application Inventor for developing the Android application.



## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Before stating any project, some ideas from other researchers or other inventors are very useful. You can take the ideas from their research likes mechanical design, control technique, program development and methodology. Thus, literature review is the beginning step to understand the ideas to develop this mobile robot project. In this chapter, detail summaries of the mobile robot development from previous researchers are determined and the present project will be compared and discussed.

#### **2.2 Previous Project Work**

##### **2.2.1 Microcontroller**

Mobile Robot controlled can be developing in many different ways. According to (Wang, Lim et al. 2014), Arduino is outlined as open-source gadgets prototyping stage giving schematics and adaptable advancement packs for eager clients who mean to deliver intuitive items or situations. Arduino can be utilized to sense surroundings by using different transducers to examine and unravel inputs with a specific end goal to make reactions for instance through the controlling of engines or exchanging of information. As a bit of equipment, the Arduino can work either independently (like in a robot), connected directly with a PC (accordingly giving your PC access to sensor information from the outside world and giving input), or joined with different Arduino's, or other electronic gadgets and controller chips. Anything can be associated and is limited just by creative ability, readiness to put eventually and exertion into discovering some new information, and the accessibility of segments. Figure 2.1 shows how Arduino connected to the PC directly using USB cable:

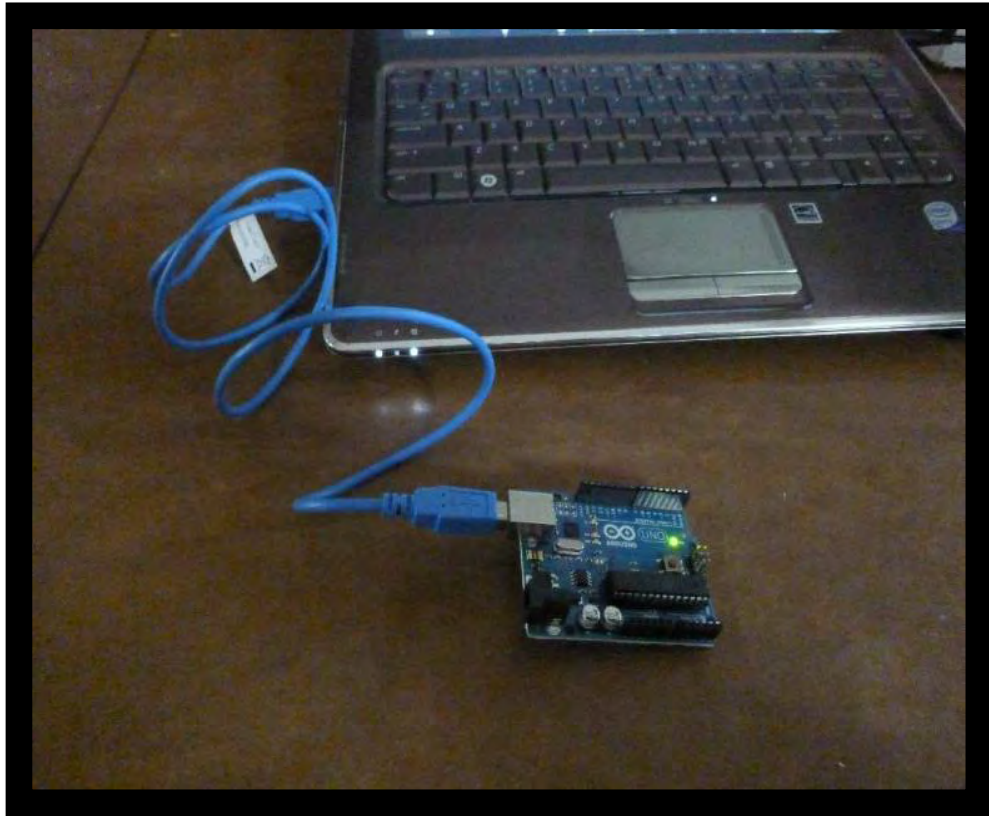


Figure 2.1: Arduino connect to PC

With assistance of the Arduino integrated development environment (IDE) in the PC, sketches are compiled and uploaded into the Arduino board via a USB transmission line. The Autonomous robot that will be controlled and mobile phone are linked via wireless communication. By touching or pressing on the screen or user interface (UI) of an Android phone, a manipulator can send commands to the Arduino microcontroller through Bluetooth and observe the corresponding executions accomplished by actuators.

Based on (Jing, Zhang et al. 2014), there are two types of Arduino that is Arduino UNO and Arduino Mega. Arduino UNO board, which is in view of the ATmega 328, is mounted vertically on the wooden case alongside the MEGA board. The Arduino UNO board is associated with a separation sensor (ultrasonic extending identifier HC-SR04) that is mounted in the front nose of the RC unit. The Arduino MEGA board produces the control for the forward/in reverse and left/right through the dc engine and servo engine introduced in the back and in the front of the

suspension, separately. The Super board works on 5V. A Bluetooth beneficiary (BT2S) is mounted on top of the MEGA board that gets the course orders from the Android gadget. The Bluetooth works at 5V and conveys through the 2.4 GHz ISM band. At the starting, when the auto unit is fueled up, the Bluetooth recipient (slave) sets with the expert (transmitter) on the Android gadget. The servo engine utilized for controlling heading is the SG90, which just measures 9g and works at 5V. Figure 2.2 shows the Flow chart of the hardware processors, Arduino MEGA and UNO boards.

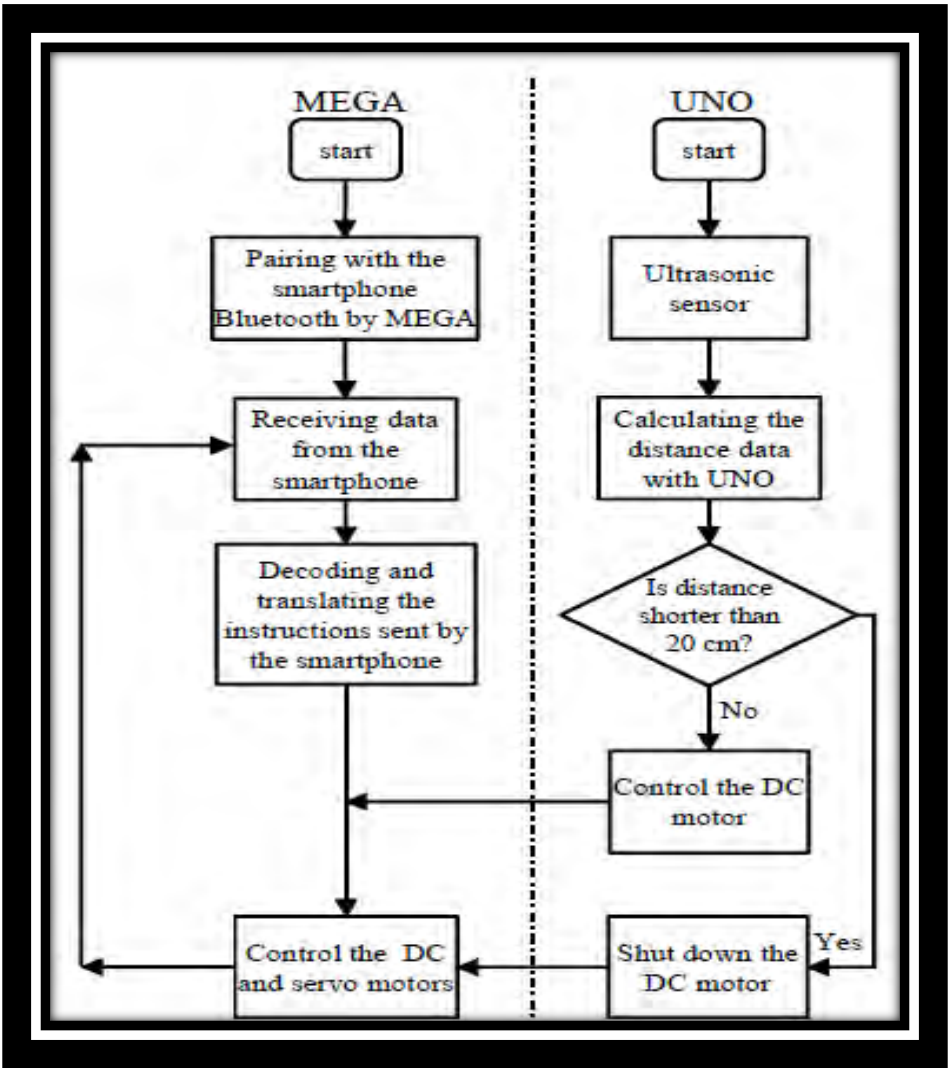


Figure 2.2: Flow chart of hardware processor, Arduino MEGA and Arduino UNO

According to (Juang and Lum 2013), Arduino is an open prototyping platform based on ATmega processor accounts and language such as C programming environment improvement, and could be linked with a variety of COTS sensors. Arduino Mega board development provided with ATmega2560 processor, which boasts the most extreme 16 MHz clock rate. To ease issues inside coding, some sort of user-friendly advancement environment, beneficial functionality libraries along with references are usually chosen. These kinds of demands are usually nicely fulfilled because of the Arduino advancement environment which usually will be based upon this C language. User-contributed functionality libraries like PWM control, I2C along with SPI connection reduce difficulties in learning to program the Arduino boards.

### **2.2.2 Wireless Connection**

Based on (Lee, Lim et al. 2014), Bluetooth module was used to send stored information on QR codes from Smartphone to the tour guide robot wirelessly. The tour guide robot is programmed to follow the wall using ultrasonic range sensors while keeping a distance of about 30cm and avoid collisions with any obstacle such as a door by sensing and measuring the distance using the front ultrasonic range sensors and the interaction between the robot and the Smartphone connect by Bluetooth. The first step shown in Figure 2.3, (1) is to establish a Bluetooth connection with the tour guide robot. The connection can be achieved by pressing “Connect to device” button on the mobile application. After the application makes the Bluetooth connection to the tour guide robot, the second step in Figure 2.3, (2) is the execution of the circle shape reader by pressing "OpenCV" button. The third step in Figure 2.3, (3) shows implementation of the circle shape reader to detect circle shape landmarks. If the circle shape reader detects more than three circles shape landmarks, a Smartphone sends using Bluetooth command to instruct the tour guide robot to reduce the robot’s wheel speed to prepare for recognition of QR codes without any problem.

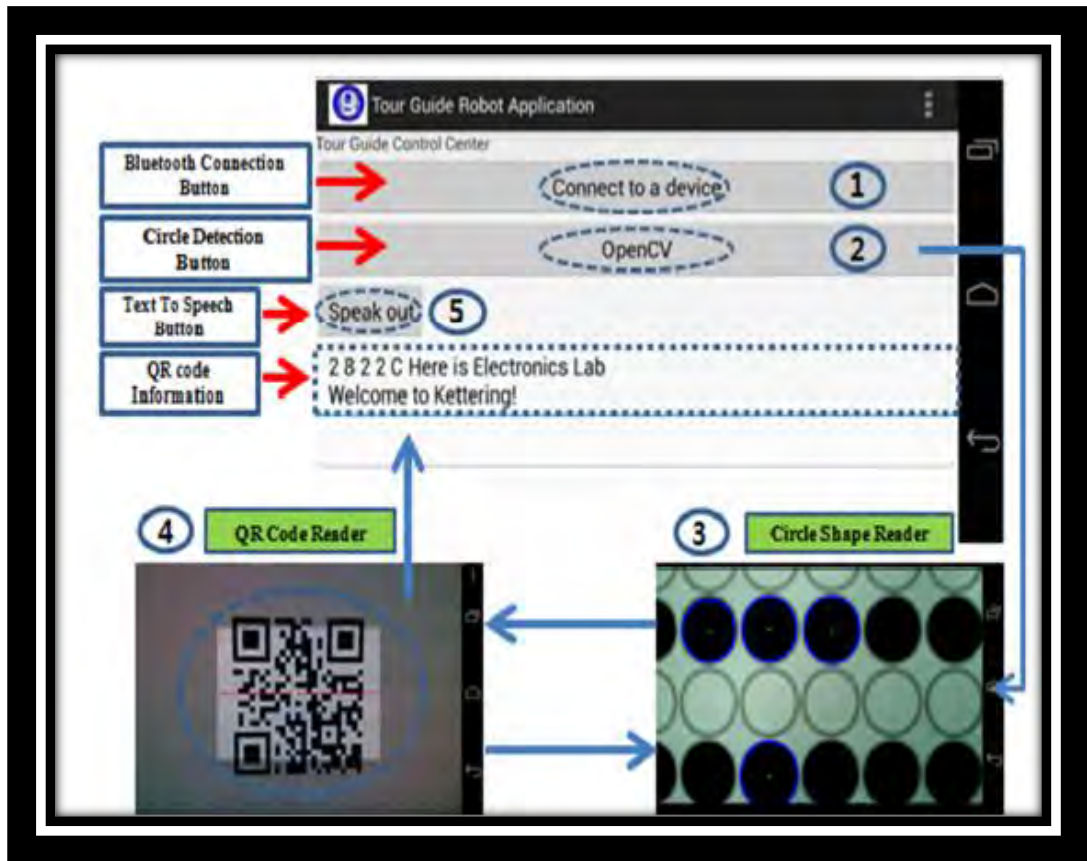


Figure 2.3: The implementation of the Smartphone application for the control the tour guide robot connected via Bluetooth.

According to (Thamrin and Sahib 2009), in order to communicate, a small networks called piconet is organized by Bluetooth in itself, comprising one master and up to 7 slave devices, in which frequency hopping sequences are synchronized and control by master. Without the piconet creation, the communication between two devices cannot occur. There are two steps in piconet creation that is inquiry process and the page process. Inquiry process is where a master device discovers neighboring slave devices, and the page process is where connection between them establishes. The Bluetooth Baseband Specification, have defined that there are three step of procedure occur in Bluetooth point to point connection. First neighborhood information is collected through the Inquiry Procedure. A Paging Procedure may be subsequently used to establish connections between neighboring devices, while in the final phase piconet properties are negotiated upon. Both the Inquiry and Paging procedures are asymmetric processes. During Inquiry, transmitting nodes discover

and collect neighborhood information provided by responding nodes that are in an Inquiry Scan state. Figure 2.5 shows the Bluetooth operation diagram.

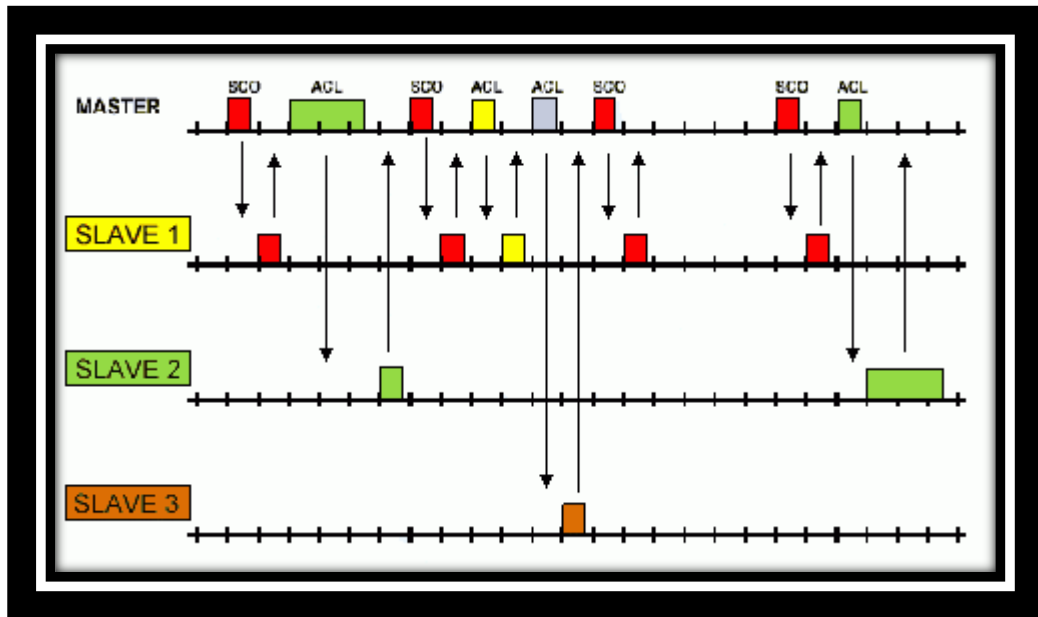


Figure 2.4: Inquiry Procedure

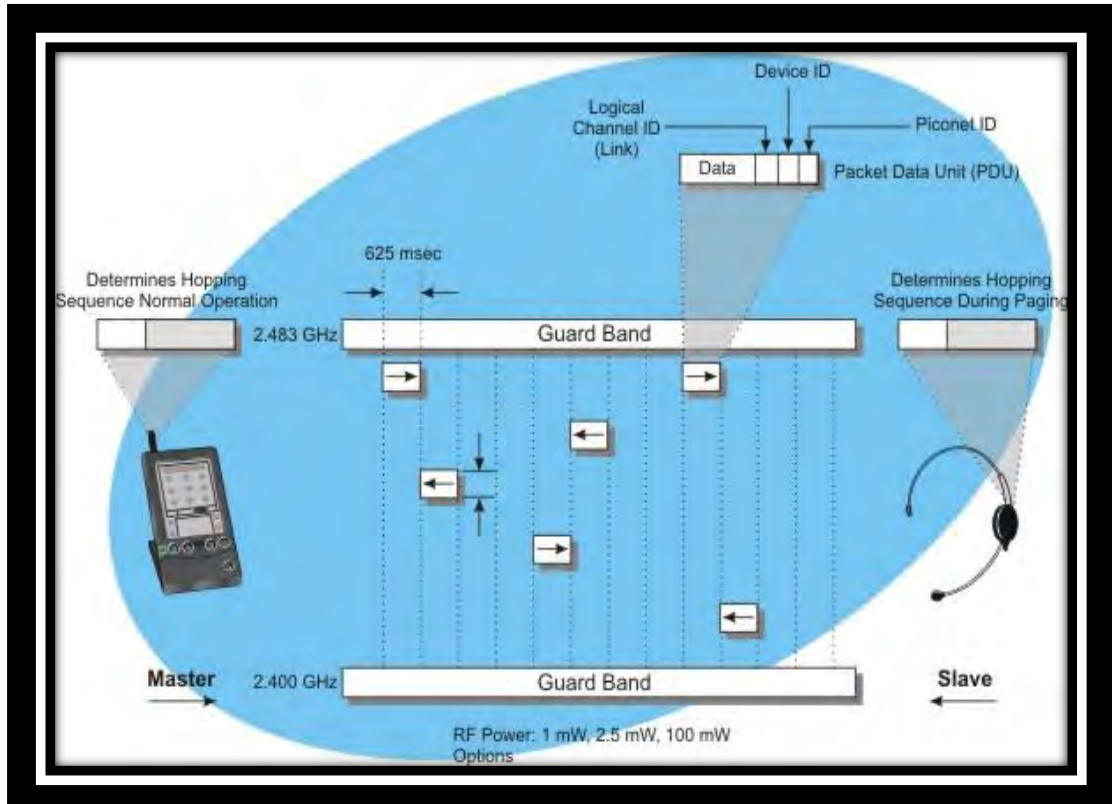


Figure 2.5: Bluetooth operation diagram

Based on (Pan, Luo et al. 2012), Bluetooth communication is based on unique MAC. Before using Bluetooth communication, the Bluetooth device must be paired first. The connected device will be shared together with a RFCOMM channel to transmit data. The Bluetooth communication is include three steps, that Query Bluetooth, Finding Device and Connecting Bluetooth. In Query Bluetooth, to get the Bluetooth activity and the method of an activity result, we can use Bluetooth Adapter. Secondly is Finding Device step, we need to open MAC address and Bluetooth user name to pair the Bluetooth and the last step is connecting the Bluetooth with device. The process of pairing connection is shown in Figure 2.6.

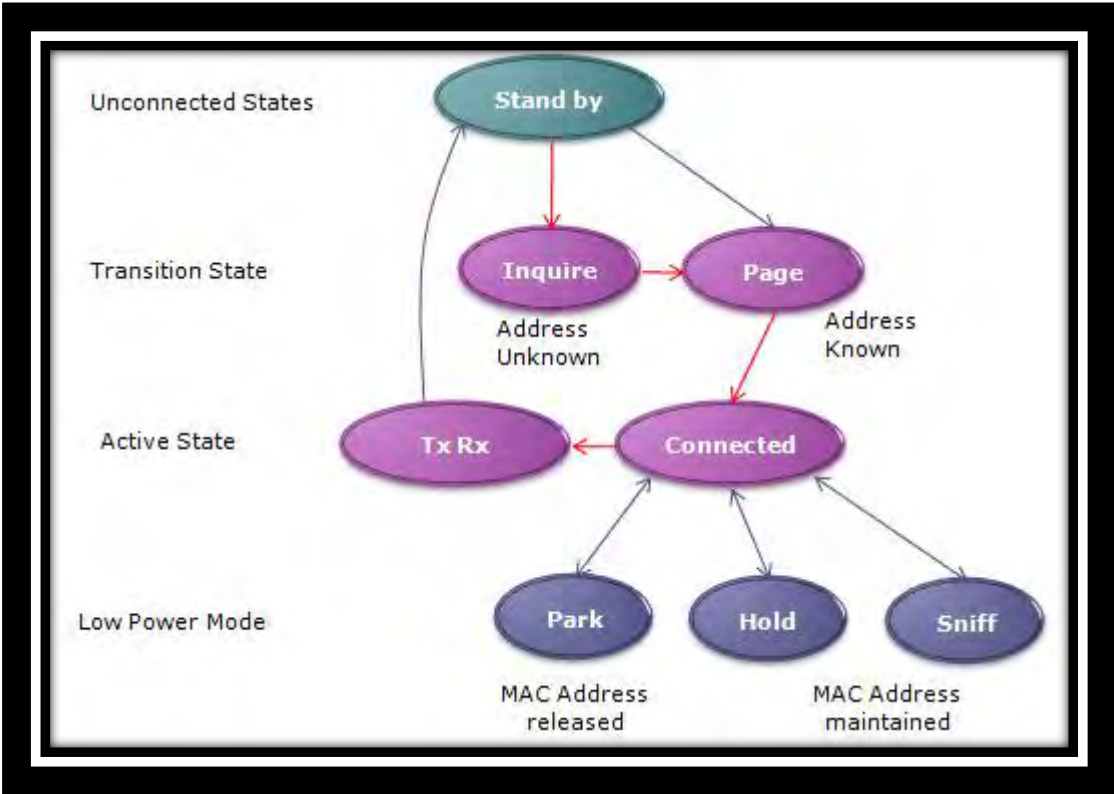


Figure 2.6: Bluetooth pairing and connection process

### 2.2.3 Android Application Development

Android is an operating system (OS) on mobile phone that was developed by Google. To develop an Android application, there is some method for people to use. According to (Nadvornik and Smutny 2014), Android application development was developed on mobile phone or tablets that are easy to handle. Applications are usually developed by using Java programming language using the Android Software Development Kit, but there are many different tools that can be used to develop the application. Eclipse using the Android Development Tools (ADT) Plug-in is the officially supported integrated development environment (IDE). Eclipse is an IDE which contains a base workspace and an extensible plug-in framework for customizing the environment. Eclipse also can be used to develop applications in other programming languages. The particular Android mobile phone computer software development system (SDK) involves a collection of development instruments. For instance, debugger, libraries, a new handset emulator primarily based, certification, test code, and also lessons. Some sort of cellular gadget emulator is usually an electronic cellular gadget of which runs upon a computer. The particular Android mobile phone emulator mimics every one of the components and also computer software attributes of a typical cellular gadget, other than which it is not able to location precise messages or calls, there's no assistance intended for Wireless and also figuring out community connected talk about.

According to (Trifunovic, Mihailovic et al. 2014), Android designers need to make some levels to get to the TR-069 client library. It is important to make the interface binding and what is not Administrative capacity needs to be implemented in Android. In addition, it is important to make the link between codes written in Java code written in C. Android engineers need to repeat information every time when the model is changed. To simplify development on the Android platform the TR-069 service is developed. Android applications can bind to the administration of Android use binding interface. For this binding interface is AIDL (Android Interface Definition Language). All that is fundamental Android designers to do is to send XML documents determine model TR-069 information to the client. After that, designers get Android by binding the administration interface and TR-069 utility customers have to be open. At this time the designers only need to call capacity