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COMPUTER ENGINEERING DEPARTMENT

Project Report

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CENG 407

Innovative System Design and Development I

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Sensor Programming with using Android Platform

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Table of Contents

Abstract

In our daily lives, sensors used in conjunction with electronic devices play a vital role in facilitating life. Today, sensor technology is used in many areas. Examples of areas where sensor technology is used include military, airport, factory, shopping mall, and hospitals. Today, there are even taps that feel the movement of the hand using the sensor. There are many sensor types such as sound, vibration, transport, electric current, magnetic, radio, distance, speed, thermal, infrared, temperature. These types of sensors can create a much more specific use of the Android platform for users. These areas of use can be particularly suitable for people with disabilities, can guide them, and can alert them to obstacles to be met. It can be programmed to facilitate everyday life. In addition, the reliability of sensors is increasing day by day in terms of security. Sensors capable of detecting explosives or weapons have vital preventive measures to detect the location of terrorists, especially in military areas, to take countermeasures against possible terrorist attacks by civilian and military personnel. There is no limit to what needs to be done with using sensor technology. The purpose of our project is to control the basic movement of the robot using the Android application. The robot will be able to check whether there is a moving object using the obstacle recognition sensor and the temperature sensor.

Key words:

Sensor Technology, Infrared Sensor, Temperature Sensor, Android Platform, Obstacle, Basic Movements, Obstacle Recognition Sensor

Özet:

Günlük yaşamlarımızda, elektronik cihazlarla birlikte kullanılan sensörler hayatı kolaylaştırmada hayati bir rol oynamaktadır. Günümüzde, sensör teknolojisi birçok alanda kullanılmaktadır. Sensör teknolojisinin kullanıldığı alanlara askeriye, havaalanları, fabrikalar, alışveriş merkezleri, hastaneler vs örnek gösterilebilir. Bugün, sensörü kullanarak elin hareketini algılayan musluklar bile vardır. Ses, titreşim, taşıma, elektrik akımı, manyetik, radyo, mesafe ölçen, hız, termal, kızılötesi ve sıcaklık gibi pek çok sensör türü bulunmaktadır. Bu tür sensörler ile, kullanıcılar için Android platformunu çok daha özel kullanım alanları oluşturabilir. Bu kullanım alanları özellikle engelli vatandaşlarımız için uygun oldur. Sensörler onlara yol gösterebilir ve karşılarına çıkacak engellere karşı onları uyarabilir. Bu

sayede sensörler günlük yaşamı kolaylaştıracak şekilde programlanabilir. Buna ek olarak, güvenlik açısından sensörlerin önemi gün geçtikçe artıyor. Patlayıcı madde veya silah tespit edebilen sensörler, özellikle de askeri alanlarda sivil ve askeri personel tarafından kullanılarak muhtemel terörist saldırılarına karşı önlem almak için önceden uyarması ile gerekli tedbirlerin alınmasını sağlar. Sensör teknolojisi kullanılarak yapılabilecek şeylerin sınırı yoktur. Projemizin amacı, Android uygulamasını kullanarak robotun temel hareketini kontrol etmektir. Robot, engel tanıma sensörünü ve sıcaklık sensörünü kullanarak tespit ettiği cismin hareketli bir nesne olup olmadığını kontrol edebilecektir.

Anahtar Kelimeler:

Sensör Teknolojisi, Kızılötesi Sensörü, Sıcaklık Sensörü, Android Program, Engel, Temel Hareketler, Engel Tanıyan Sensör

1. Introduction

The most common areas of use for robotic sensors are different device types like Android-based mobile phone, tablet computer, smart clock. Through these devices, we can send and receive data to the sensors. An example of this is to control a robot with an Android smartphone. Through this communication between the devices, we can easily implement our needs.The user can use any button on mobile devices or say some words to other intelligent devices such as robots, watches, or some applications.

1.1 Problem Statement

The most common areas of use for robotic sensors are different device types like Android-based mobile phone, tablet computer, smart clock. Through these devices, we can send and receive data to the sensors. An example of this is to control a robot with an Android smartphone. Through this communication between the devices, we can easily implement our needs.The user can use any button on mobile devices or say some words to other intelligent devices such as robots, watches, or some applications.

The target group of this project is, someone who has an Android device and knows how to use this Android device and who has a Bluetooth connection can take advantage of this project. But our primary goal is to identify enemies in the military field. If the project is to be successful and military space is to be used, the enemy will be easily detected by the heat (infrared) and obstacle detection sensor.

1.2 Related Work

Designed the robot [1] will be controlled by an Android application and connectivity between the robot and smartphone will be based on the Bluetooth technology. Android application can send data to the robot using Bluetooth module which connected to Arduino. Those data will send the data to micro-controller. When sending input from users to the microcontroller, the microcontroller will process the data. After that, the robot can move according to with this output. Android devices have many hardware components, such as orientation sensors, proximity sensors. Sharma at all.[2] new generation smartphones have proximity sensors and acceleration sensors also included Bluetooth module and are powered by different operating systems such as Android. In our research, we have seen that different applications have been made about the Bluetooth controlled robots. If we look at [3], this thesis was written about using Bluetooth technology in Android phones to control the direction of movement of the robot and additionally to adapt robot to move light objects with the aid of the added motor.

Robot control is provided with Bluetooth on Android phones. (Figure 1)

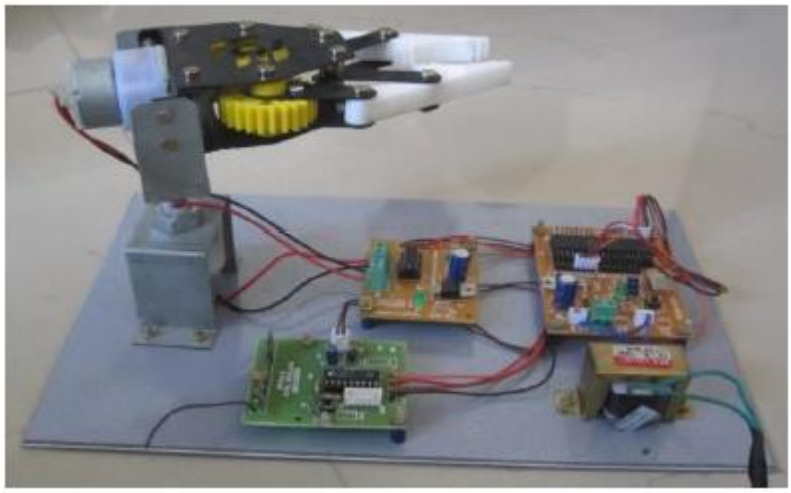

Figure 1. Sruthilaya's Robot

The system [4], consists of four-part. These are such as:

1)Bluetooth technology

2)Smartphone with Android operating system,

3)Microprocessor (Arduino Uno R3)

4) DC Motor.

Arduino Uno R3 which used a microprocessor based on ATmega328P is the robot's brain. Bluetooth is the bridge between the robot and the smartphone. The phone provides remote control of the robot. The DC motor makes the system moving. DC motor driver L293D is used here [6]. This motor driver helps attached two DC motors each other. They also used the HC-06 Bluetooth module to provide connectivity and designed a tiny car as a robot. In addition to this, some theses have been used in extra parts. Loic Frund [7], he used the proximity sensor, the ground sensor while developing a robot. And also used, microphone, speaker, and GPS. Another thesis Muhammed Jabir.N.K at all.[8], they used a soft catch to remove light boxes and also this thesis [9] used the soft catch arm to remove light boxes.

1.3 Solution Statement

In this section, we will share our solutions to the problems that are mentioned in the section of Problem Statement.

The purpose of our project is to control the basic movements of the robot using the Android application. The user must first install the Android application on the phone before the robot and the android device can communicate with each other. After installing the application, it can begin to use the application without any system registry. Once the user has entered the application, the robot should check to see if it is open. If it is not open, the robot should activate the robot with the on / off button. The user should also check that the Bluetooth connection is active on the device at the same time. If the robot is open and the user has turned on the application, then the interaction between the application and the robot is initiated via the Bluetooth connection. In the application, the user can move forward, backward, right, left with the help of the robot. The robot will be obstructed in the face of progress. The robot will be able to check whether these obstacles are moving objects using the obstacle recognition and temperature sensor. The robot will switch on the obstacle recognition sensor in the first place to see if there is an obstacle in front of it. If it detects an obstacle in front of you, it will activate the heat sensor (infrared sensor) with the body temperature of the living thing in mind. If it is the living thing, it will give a strong signal to warn. This is a prototype of a robot that can be used to detect a terrorist in the military field. This robot will deliver much better results using more robust and sophisticated materials.

1.4 Motivation

We are senior students interested in Robotics in Computer Engineering department. As a group, we have taken courses in Microprocessors. In this project, the microprocessor and the application communicate with each other. We use the Java language for the application. We use C language for the microprocessor. In this way, we communicate between the two languages and between the microprocessor and the application.

2. Literature Search

There is a growing literature on sensors used for robot technology on Android platforms. The Android platform is an open-source, Linux-based operating system purchased by Google from Android Inc.in 2005 for smartphones and mobile devices. Android devices have many hardware components, such as orientation sensors, proximity sensors. And it also consists of software components such as operating system and core applications. In this regard, smartphones are becoming more powerful.Since it contains a lot of hardware components depending on the demand, it has become useful for robot control The goal of our project is to control basic robotic movements with using sensors on Android application. In this article, we have reviewed the academic thesis and articles that have provided the Android operating system and the robot control through Bluetooth. We identified and searched 11 works that have appeared in conferences and journals. We mentioned the source addresses of theses that we have examined in the reference section. We also summarized the results of the thesis in the conclusion part.

2.1. Robotic Sensors

The most common areas of use for robotic sensors are different device types like Android-based mobile phone, tablet computer, smart clock. Through these devices, we can send and receive data to the sensors. An example of this is to control a robot with an Android smartphone. Through this communication between the devices, we can easily implement our needs. The user can use any button on mobile devices or say some words to other intelligent devices such as robots, watches, or some applications.

2.2 How Robotic sensor is work?

Designed the robot [1] will be controlled by an Android application and connectivity between the robot and smartphone will be based on the Bluetooth technology. Android application can send data to the robot using Bluetooth module which connected to Arduino. Those data will send the data to micro-controller. When sending input from users to the microcontroller, the microcontroller will process the data. After that, the robot can move according to with this output. Android devices have many hardware components, such as orientation sensors, proximity sensors. Sharma at all. [2] new generation smartphones have proximity sensors and acceleration sensors also included Bluetooth module and are powered by different operating

systems such as Android. In our research, we have seen that different applications have been made about the Bluetooth controlled robots. If we look at [3], this thesis was written about using Bluetooth technology in Android phones to control the direction of movement of the robot and additionally to adapt robot to move light objects with the aid of the added motor. Robot control is provided with Bluetooth on Android phones.

2.3 Parts and Properties of Robotic Sensor Elements

The system [4], consists of four-part. These are such as:

1)Bluetooth technology

2)Smartphone with Android operating system,

3)Microprocessor (Arduino Uno R3)

4) DC Motor.

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2.4 Programming Language

Now let's see what programming languages are used. Jan Nadvornik at all. [10] used Java, Eclipse for Android phone application. Another thesis [11], they used Integrated Development Environment (IDE) is used for Arduino Uno's comments and messages. Also, they used Java Development Kit(JDK) for Java application and Java language and used Eclipse for writing Java codes.

2.5 Usage Areas

Saurabh Khoje [1] Robots can be programmed for many different types of calculation which is very important and useful machines for use in industries, fabrication, manufacturing defect, and health industries. Robots can make faster and more accurate calculations when compared to humans. Nowadays Robotic systems are becoming more and more developed because of people needs.

3. Summary

In conclusion, [1] designed this project for creating a robot which can be controlled with Bluetooth with Android device. For this application, life can be easier. We can add more features like Wi-Fi connectivity, robotic arms, camera and different types of sensors for this project. There is no limit to what can be done using any types of sensors such as, speed sensor, temperature sensor, PIR sensor, ultrasonic sensor, etc. Also, [5] such projects will be a source of inspiration for projects to facilitate the lives of people with disabilities.

4. Software Requirements Specification

4.1 Introduction

4.1.1 Purpose

The purpose of this document is describing the project which is called sensor programming with using the Android platform.

Our goal in this project is to create robots that recognize the obstacles. This document includes detailed information about requirements of the project. It reflects the identified constraints and proposed software functionalities. Moreover, the SRS document explains how the user interacts with the project.

4.1.2 Scope of Project

In our daily lives, sensors used in conjunction with electronic devices play a vital role in facilitating life. Today, sensor technology is used in many areas. Examples of areas where sensor technology is used include military, airport, factory, shopping mall, and hospitals. Today, there are even taps that feel the movement of the hand using the sensor. There are many sensor types such as sound, vibration, transport, electric current, magnetic, radio, distance, speed, thermal, infrared, temperature. These types of sensors can create a much more specific use of the Android platform for users. These areas of use can be particularly suitable for people with disabilities, can guide them, and can alert them to obstacles to be met. It can be programmed to facilitate everyday life. In addition, the reliability of sensors is increasing day by day in terms of security. Sensors capable of detecting explosives or weapons have vital preventive measures to detect the location of terrorists, especially in military areas, to take countermeasures against possible terrorist attacks by civilian and military personnel. On the other hand, the sensor technology is being sold at a reasonable price as its use becomes more widespread over the years when it was first produced. This cost is cheap and easily accessible, especially in the Chinese market. There is no limit to what needs to be done with using sensor technology. These sensors are most commonly used devices, such as Android-based mobile phones, tablets, smart clocks. With these devices, we can send data to sensors and easily receive data. An example of this is to control a robot with an Android smartphone. With this communication between the devices, we can easily implement our needs. We have more than one option to communicate between devices. You can use any button on the mobile device, or you can say some words (voice commands) to other smart devices, such as a robot, clock, or some applications, or alert you to an obstacle when you see an obstacle. The purpose of our project is to control the basic movement of the robot using the Android application. The robot will be able to check whether there is a moving object using the obstacle recognition sensor

and the temperature sensor. In addition, this robot can be used in military areas if robust and advanced materials are used. In short, this project is a prototype of a robot that can be used in a more advanced and military field. In this project, there is only one user as an actor. During this project, the user can control the robot using Android devices. The user will be able to use the Android device to control basic movements such as left, right, forward, and backward movement.

4.1.3 Glossary

Table 1 Glossary of SRS

Term	Definition
User	The user who interacts with the application. Anyone with an Android phone can use this application.
Arduino Uno	The Arduino Uno is the robot's brain [1]
DC Motor	The DC motor makes the system moving
HC-06 Bluetooth Module	The HC-06 Bluetooth module to provide connectivity and designed a tiny car as a robot.
Android Devices	The Android devices provide remote control of the robot.
Software Requirements Specification	A document that completely describes all of the functions of a proposed system and the constraints under which it must operate. For example, this document.
Ultrasonic Sensor	Ultrasonic sensors are sensors that emit ultrasonic sound waves and can determine the distance between them by calculating the time it takes for them to strike the obstacles.
Motor Shield	The Motor Shield controls the speed and direction of the motor.

4.1.4 References

[1] Verma, S, Android App Controlled the Bluetooth Robot, Internal Journal of Computer Applications, vol 152, no 9, p.35- 40

4.1.5 Overview of Document

The second part of the document describes functionalities of the sensor programming with using the Android platform. Informal requirements are described and it is a context for technical requirement specification in the Requirement Specification chapter.Requirement Specification chapter is written for software developers and details of the functionality of the application are described in technical terms.

4.2 Overall Description

4.2.1 Product Perspective

Sensor programming using the Android platform is a system that allows the user to control the robot in real time with the Bluetooth module. Thanks to the exchange of data, the robot informs the user that the obstacle is due to the ultrasonic sensor and the infrared and thermal sensor. At this point, data exchange takes place between the user and the robot.

4.2.2 Development Methodology

While developing the project, we planned to use the Scrum of the Agile software development methodology. A brief description of Scrum is the application development method in software engineering. The basic feature of this development method depends on the observer, the developer, and the repetition. The product owner is the person who gives the products quests, the scrum manager who manages the development team, and a development team is a group of developers working on the program according to the program. The development team has a daily meeting every morning which should be maximum 15 minutes. First, the development and problems of the project are kept on a daily basis and the development of the project is monitored by everyone. At the next stage, product functions are delivered to the customer at regular intervals and evaluated by the customer. And finally, product requirements are not determined at the same time, they are evaluated repeatedly, and adaptations and adjustments are made according to the situation. The aim is to produce the desired product quickly, cheaply and in good quality. Scrum's period of time which could be 30 days on average. The actions requested by the user are developed and re-glanced over a period of two or four weeks called "Sprint" (figure 2). These sprints are based on the requirements of the user. At the end of each Sprint, the functional part of the software is gone and the customer is available for delivery(presented to the customer for validation). Scrum is a method for experiencing agile software development principles. For this reason, the scrum board consists of six phases. These are such as (figure 3):

1) ("Project Needs") are all processes.

2) ("ToDo") priority.

3) ("During Progress") there are tasks created.

4) ("Review") is shown through the eyes.

5) ("To Deploy") contains the modules that are ready.

6) ("Done") indicates processes that are running successfully.

Members of the software team will give you a brief overview of what tasks you are working on in Scrum the day before and what your tasks are about to finish. Tasks that will not finish in a day are marked with a red dot. Thus, the obstacle to be encountered is easily detected and resumed from where it left off. The advantages of Scrum is included working with specialists in with small size group, playing an important role in communication, facilitating information sharing with day-to-day meetings, self-organization, and self-planning [1]. It also focuses on the consistency of stages and the duration of the order with software development process models to improve the intended software product within time and cost estimates [2].

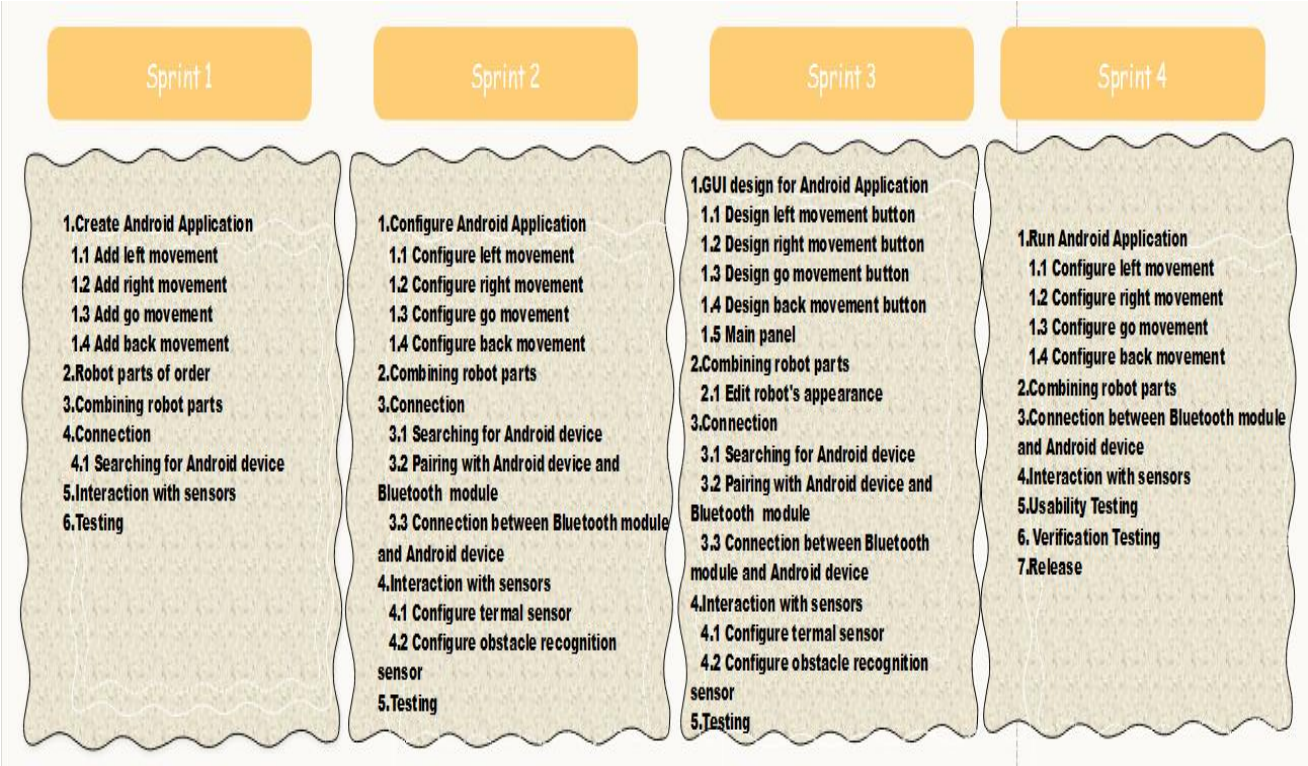

Figure 2. All sprints on the Scrum Board

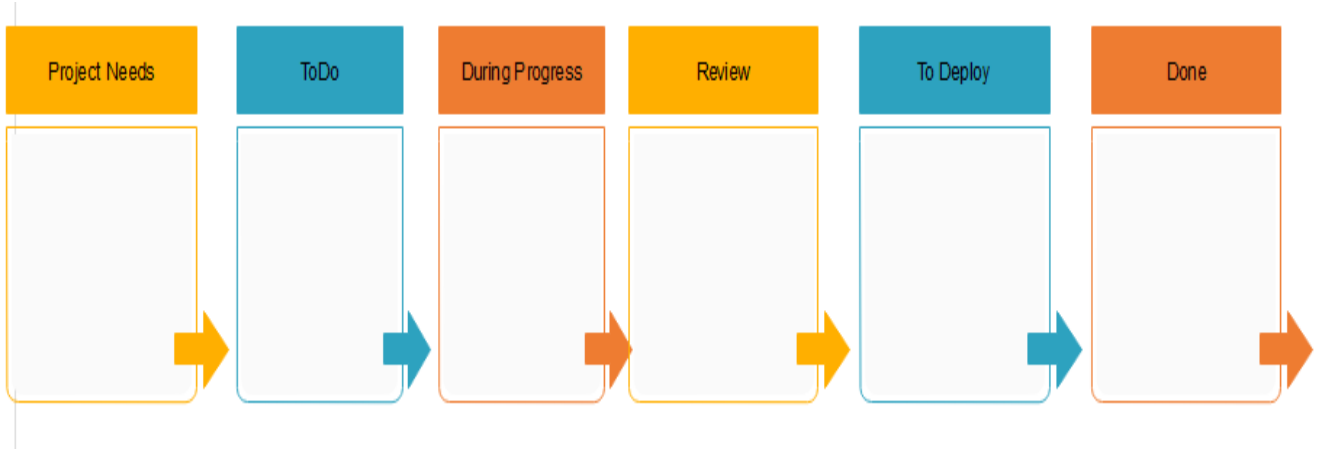

Figure 3. Scrum Board with task

The Gantt Chart is simply referred to as a business plan chart. This chart determines which job is to be done and when. The Gantt Chart is an application that is very useful in project management processes. With the Gantt chart, the work to be done in a project is divided into sub-sections to determine what work will take and how long it will take.

The project manager uses the Gantt chart to monitor and assess the work of the project. Job titles, durations, and dependencies are determined on the chart (Figure 4).

What works in a project is written once, or sometimes it is kept in mind, and when things start to blend in the project, and when the time is constrained, it may not be clear what time it will work and how long it will work. In summary, with this application, work, personnel and time can be done in the project.

Figure 4. Gantt Chart

4.2.3. User Characteristics

4.2.3.1. Participant

Participant must be anyone who can use Android devices.

4.3 Requirements Specification

4.3.1 External Interface Requirements

4.3.1.1 User interfaces

The user interface will be worked on Android platform.

4.3.1.2. Hardware interfaces

The project requires Android device. The Android device requires necessary drivers installed on the Android platform. Also, it requires Bluetooth connection. The robot requires two DC Motors, obstacle recognition sensor, a thermal sensor, Arduino Uno, Bluetooth module.

4.3.1.3. Software interfaces

There is only software interface for the Android phone application. In this application, there will be left, right, go, back buttons and their interfaces.

4.3.1.4. Communications interfaces

As a communication interface, there is a Bluetooth module that exchanges data between the robot and the Android device. In addition, the obstacle detection sensor and the temperature sensor enable the determination of the obstacles to be encountered.

4.3.2 Functional Requirements

4.3.2.1 Menu Use Case for User

Use Case:

Left

Right

Go

Back

Exit

Diagram:

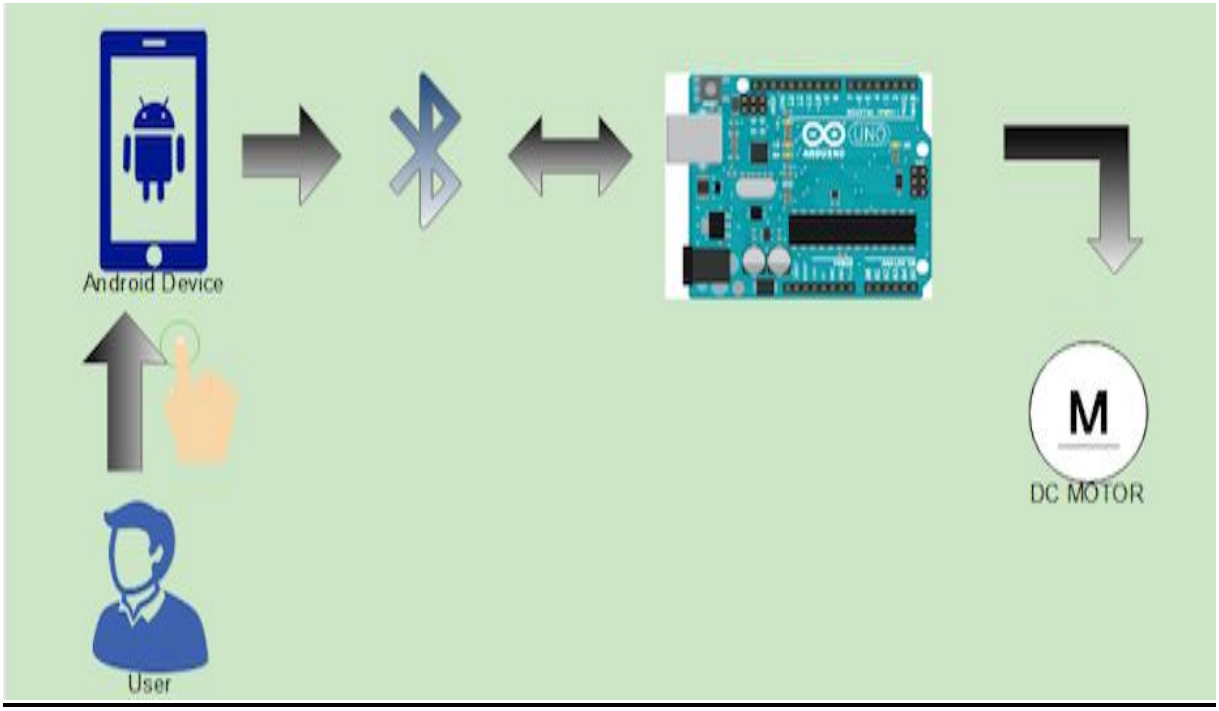

Figure 5. Menu Use Case for User

Brief Description:

Figure 5 shows menu use case for user diagram. When the user entered the application, the user can display the controls menu then the user can control the robot by using this application. A user can execute functions of move right, move left, go and back.

Initial Step-By-Step Description:

1. The user can start an application without login.
2. If the user selects go button, the robot moves ahead.
3. If the user selects back button, the robot moves back.
4. If the user selects the left button, the robot moves left.
5. If the user selects the right button, the robot moves right.

4.3.3 Performance Requirement

Minimum requirements for running application are:

1. Device: Android Devices
2. Operating system: Android (version 3.0 or higher)

4.3.4 Software System attributes

4.3.4.1 Portability

The application can design for Android platform.

4.3.4.2. Performance

There will be no problem in terms of performance because the application is a simple application.

The user should be as close as possible to the device because of Bluetooth is limited connection area.

4.3.4.3. Usability

When the Bluetooth connection fails, an error message, which explains the reason that why the Bluetooth lose connection should be displayed.

4.3.4.4. Adaptability

Since no data is acquired and saved from the runtime, there is no adaptability requirement.

4.3.4.5 Scalability

Since only one user uses the system at a time, there is no scalability requirement.

4.3.5 Safety Requirement

Bluetooth requires at most 10 meters square area. There may be an obstacle in the working environment. The robot recognizes these obstacles 10 cm in advance using the sensor. If the robots crash the obstacles, the robot may be damaged.

As a result of excessive use, the eyes of the user may be deteriorated and the user may be exposed to radiation.

5. Software Design Description

5.1 Introduction

5.1.1 Purpose

The purpose of this Software Design Document (SDD) is to present the details of the project entitled "Sensor programming using the Android platform".

The target group of this project is, someone who has an Android device and knows how to use this Android device and who has a Bluetooth connection can take advantage of this project. But our primary goal is to identify enemies in the military field. If the project is to be successful and military space is to be used, the enemy will be easily detected by the heat (infrared) and obstacle detection sensor.

The purpose of our project is to control the basic movements of the robot using the Android application. The user must first install the Android application on the phone before the robot and the android device can communicate with each other. After installing the application, it can begin to use the application without any system registry. Once the user has entered the application, the robot should check to see if it is open. If it is not open, the robot should activate the robot with the on / off button. The user should also check that the Bluetooth connection is active on the device at the same time. If the robot is open and the user has turned on the application, then the interaction between the application and the robot is initiated via the Bluetooth connection. In the application, the user can move forward, backward, right, left with the help of the robot. The robot will be obstructed in the face of progress. The robot will be able to check whether these obstacles are moving objects using the obstacle recognition and temperature sensor. The robot will switch on the obstacle recognition sensor in the first place to see if there is an obstacle in front of it. If it detects an obstacle in front of you, it will activate the heat sensor (infrared sensor) with the body temperature of the living thing in mind. If it is the living thing, it will give a strong signal to warn. This is a prototype of a robot that can be used to detect a terrorist in the military field. This robot will deliver much better results using more robust and sophisticated materials.

To provide a better understanding, this SDD includes various diagrams such as UML diagram, activity diagram.

5.1.2 Scope

This document contains a complete description of the design of Sensor programming with using Android devices.

The Android platform, which has a Linux-based operating system, is being developed by communities such as Google and the Open Handset Alliance.It is an operating system which is low cost and open source code. Originally used for tablets and smartphones, today's applications

are developing and are almost using everywhere in our lives.

The Android operating system consists of 4 layers. [1] (figure 6)

1- Linux Kernel
2- Libraries & Android Runtime
3- Application Framework
4- Applications

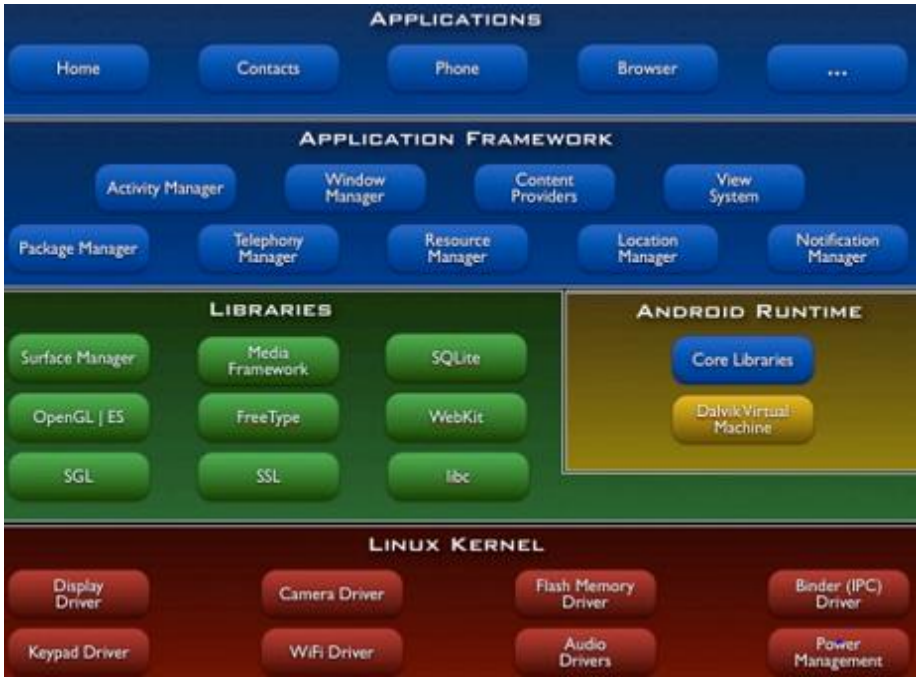

Figure 6. Android Layers

As we can see in Figure 1, the Kernel is the first layer of the Android operating system which is used for memory management, process management, and networking. The second layer is Libraries and Runtime which includes all libraries on the Android operating system are written in C and C ++. It is invoked via java interface. This layer works with the Dalvik virtual machine. This also serves as a kind of translator between the application and the operating system. The third layer is application framework which is used to determine the structure of an application for the Android operating system. The fourth and last layer is Applications which provides interaction between applications written in Java and users.

We decided to implement our sensor application on the Android platform. We decided to use the Java language while developing an app for the Android device. And we will use the Eclipse program for this Java language.

Microprocessors are small computers which are programmed using various languages such as C / C ++, assembly, and run only one program. They have their own RAM memory and program memory, which is normally too small. The microprocessor is the robot's brain [2]. Two of the most popular microprocessors in the market which are Raspberry Pi and Arduino UNO. Arduino is an open source hardware and software platform that uses Atmel 8,16 or 32-bit AVR microcontrollers. The most popular Arduino is the Arduino UNO. Arduino is an open source hardware and software platform that uses Atmel 8,16 or 32-bit AVR microcontrollers. The most popular Arduino card is the Arduino UNO model. It can be easily programmed with Arduino libraries. It can detect signals by receiving analog and digital signals. Using signals from sensors, it helps to design robots and systems that interact with the environment. In this way, actions specific to the project, such as sound, light can create reactions. Raspberry Pi is a low-priced computer. It has the ability to work as a fully functioning computer, requiring fewer peripherals. Usually used with Linux operating systems.

We decided to use Arduino UNO (Figure 7) in our project. Because it is cheaper than Raspberry PI and we are at the beginning level, it will be easier for us. We decided to code Arduino UNO with the C language. The program we will code Arduino is a special coding program for Arduino.

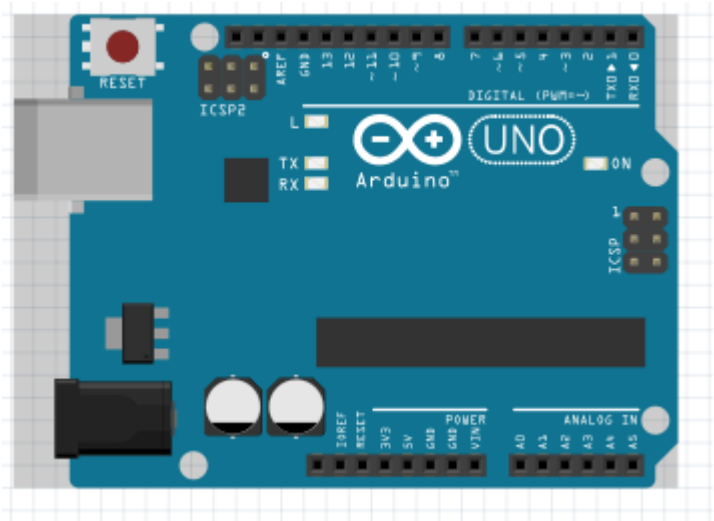

Figure 7. Arduino Uno

In our daily lives, sensors used in conjunction with electronic devices play a vital role in facilitating life. Today, sensor technology is used in many areas. Examples of areas where sensor technology is used include military, airport, factory, shopping mall, and hospitals. Today, there are even taps that feel the movement of the hand using the sensor. There are many sensor types

such as sound, vibration, transport, electric current, magnetic, radio, distance, speed, thermal, infrared, temperature. These types of sensors can create a much more specific use of the Android platform for users. These areas of use can be particularly suitable for people with disabilities, can guide them, and can alert them to obstacles to be met. It can be programmed to facilitate everyday life. In addition, the reliability of sensors is increasing day by day in terms of security. Sensors capable of detecting explosives or weapons have vital preventive measures to detect the location of terrorists, especially in military areas, to take countermeasures against possible terrorist attacks by civilian and military personnel. On the other hand, the sensor technology is being sold at a reasonable price as its use becomes more widespread over the years when it was first produced. This cost is cheap and easily accessible, especially in the Chinese market. There is no limit to what needs to be done with using sensor technology. These sensors are most commonly used devices, such as Android-based mobile phones, tablets, smart clocks. With these devices, we can send data to sensors and easily receive data. An example of this is to control a robot with an Android smartphone. With this communication between the devices, we can easily implement our needs. We have more than one option to communicate between devices. You can use any button on the mobile device, or you can say some words (voice commands) to other smart devices, such as a robot, clock, or some applications, or alert you to an obstacle when you see an obstacle. The purpose of our project is to control the basic movement of the robot using the Android application. The robot will be able to check whether there is a moving object using the obstacle recognition sensor and the temperature sensor.

5.1.3 Glossary

Table 2 Glossary of SDD

Term	Definition
Block Diagram	The type of schema which the components in the system are displayed in blocks.
User	The user who interacts with the application. Anyone with an Android phone can use this application.
DC Motor	The DC motor makes the system moving
Android Devices	The Android devices provide remote control of the robot.
Motor Shield	The Motor Shield controls the speed and direction of the motor.
SDD	Software Design Document
UML Diagram	It is a modeling language which is used in Software Engineering.

5.1.4 Overview of document

The remaining chapters and their contents are listed below.

Section 2 is the Architectural Design which describes the project development phase. Also, it contains a class diagram of the system and architecture design of the Robot's which describes the user, pre-conditions, and post-conditions. Additionally, this section includes activity diagram of sensor programming.

Section 3 is Use Case Realization. In this section, a block diagram of the system, which is designed according to use cases in SRS document, is displayed and explained and explained prototype how it was used.

5.2 Class Diagram

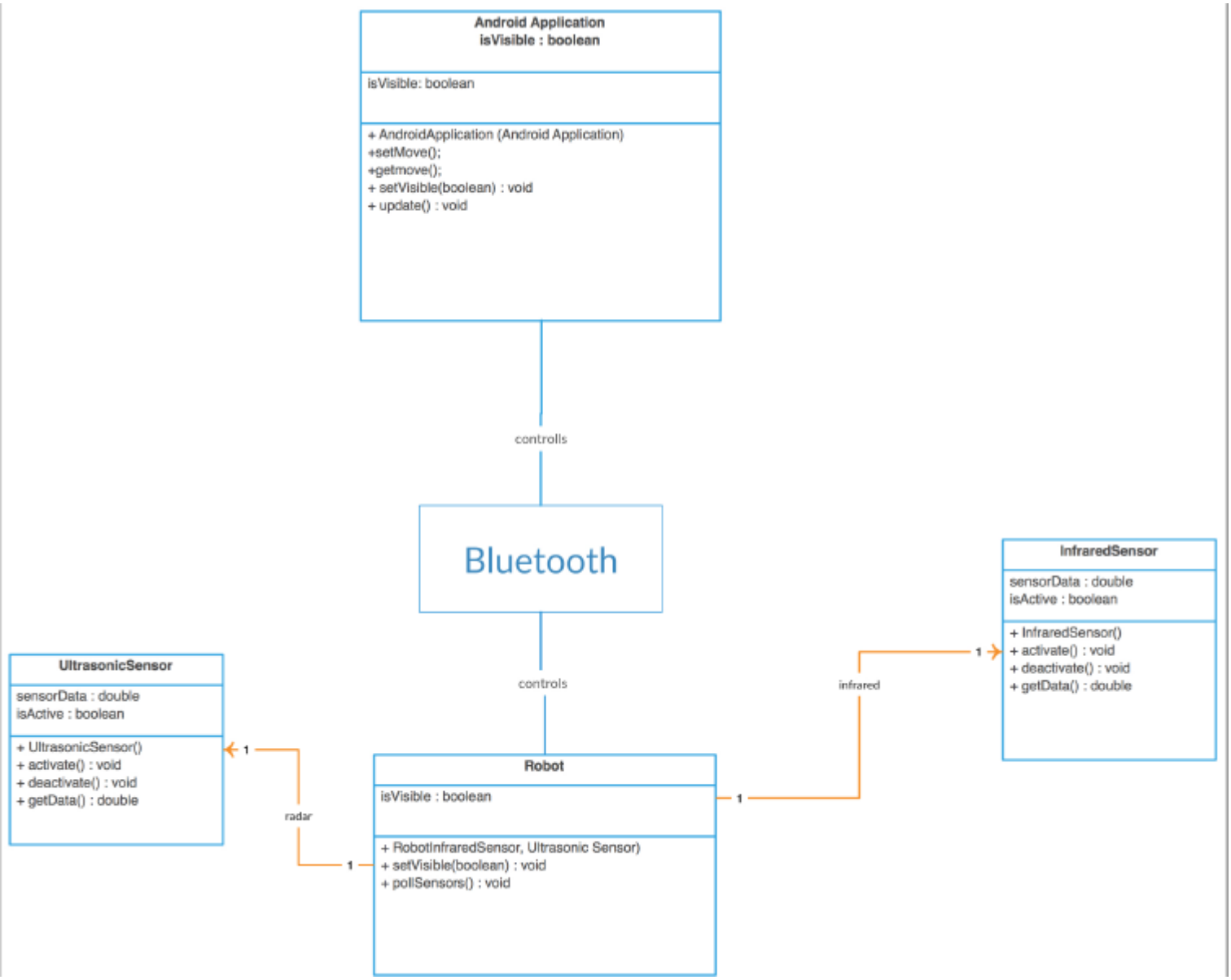

Figure 8. Class Diagram for Sensor Programming

Figure 8 displays information about connections between the systems within the project.

Robot Class is the main system, which contains other systems. It is responsible for connections between other systems such as Android Application, Ultrasonic Sensor, and Infrared Sensor. Android Application class represents user control the Robot's movement methods such as go, back, turn left and turn right. Ultrasonic Sensor class is the part where the robot recognizes the obstacles. Admin class is an actor which manages the system. Infrared Sensor class detects the

temperature of the obstacle detected by the ultrasonic sensor.

5.3 Architecture Design of Project

5.3.1 Profile Management

Summary: This system is used by the user. The user controls the movements of the robot's basic movements such as turning left and turning right and going ahead and back. The user can exit from the system.

Actor: User

Precondition: User must run the program.

Basic Sequence:

1. The user can start an application without login.
2. If the user selects go button, the robot moves ahead
3. If the user selects back button, the robot moves back.
4. If the user selects the left button, the robot moves left.
5. If the user selects the right button, the robot moves right.

Exception: Bluetooth connection can be failed.

Post Conditions: Bluetooth must be connected to the device.

Priority: High

5.4 **Activity Diagram**

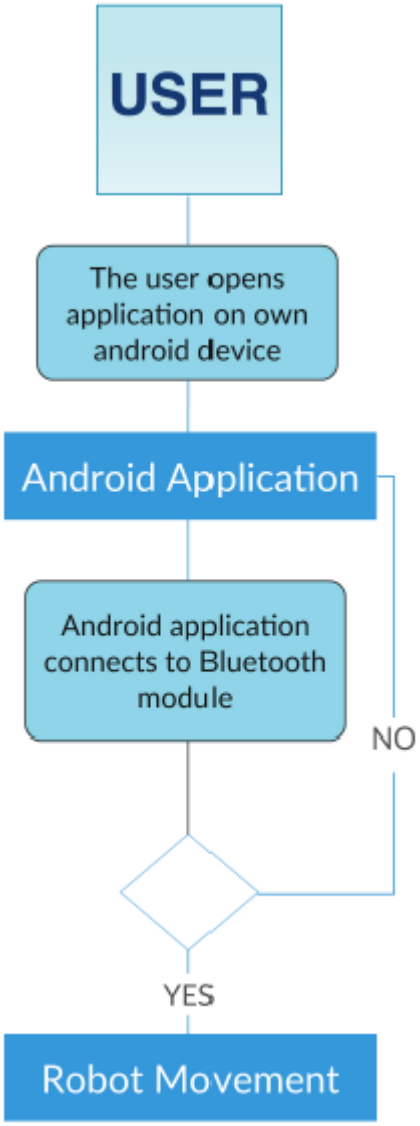

Figure 9. Activity Diagram

Figure 9 shows how the Sensor programming works as an activity diagram. As a first step, the user will open the Bluetooth connection on the Android device. The user will launch the Android application which is installed. If the Bluetooth connection is not turned on and the application is started, the user will exit the application and return to the first stage. If the Bluetooth connection is on, the user will start using the movement keys to move the robot. In this way, the user can control the movement of the robot.

5.5. USE CASE REALIZATIONS

5.5.1 Menu Use Case for User

Use Case:

Left

Right

Go

Back

Exit

Diagram:

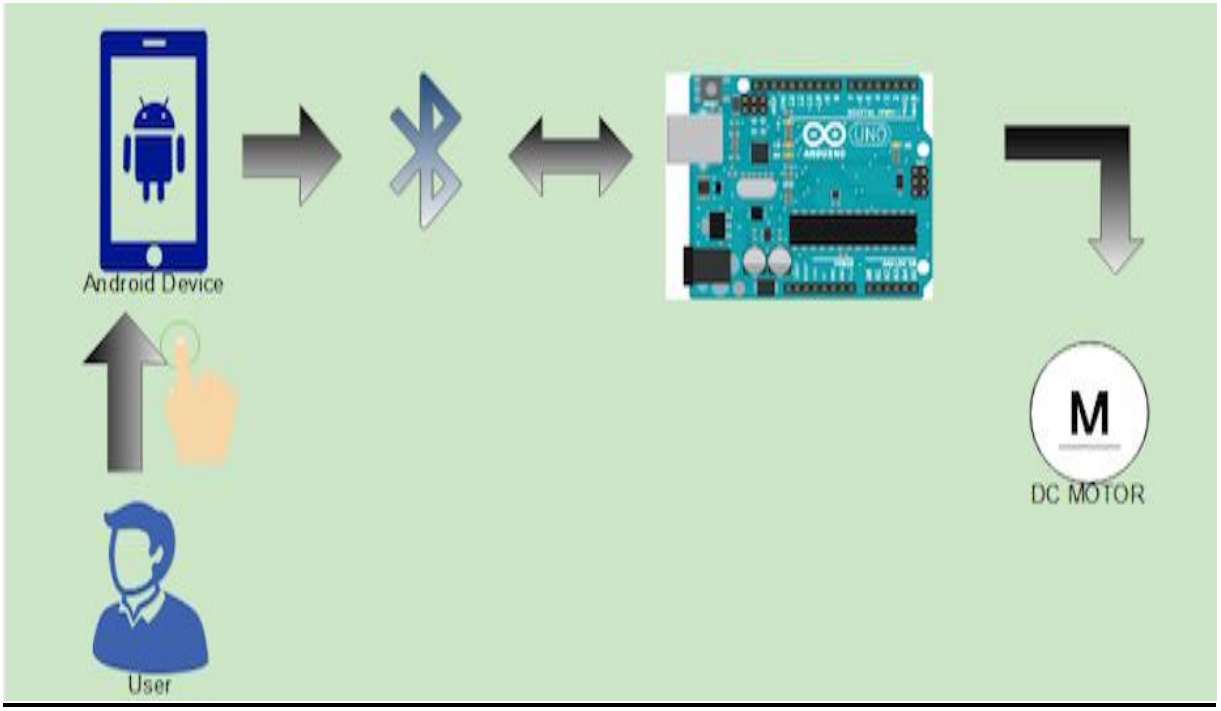

Figure 10. Menu Use Case for User

5.5.1.1 Brief Description of Figure 10:

Figure 10 shows menu use case for user diagram. When the user entered the application, the user can display the controls menu then the user can control the robot by using this application. A user can execute functions of move right, move left, go and back.

6. Conclusions

This document contains extensive information about our project entitled "Sensor Programming with Android Platform".
While we were developing this project, we conducted researches on the title of the topic which our teacher gave. We designed and thought what we could do. And we decided to make a robot that uses the sensor that detects the obstacle. Our ideas have changed a lot since then. Finally, with the obstacle-recognized sensor, robot wanted to decide if the obstacle was alive. We have studied the relevant studies related to this topic. We searched for what they used. We wrote the SRS document in the light of this information. After SRS, we wrote SDD in more detail. We have developed a basic prototype of the project, and we have developed our methodology, designed the architecture and the product to the customer.

When we developed this project, we did some research on which microprocessor we should use. As a result of our research, we decided to use Arduino Uno.

In this project, we used Android Platform and Bluetooth technology to interact with the two devices. One of our devices is the Smart device that owns the Android app, and the other is Arduino Uno, the brain of the robot. Using various sensors connected to the Arduino Uno, we have acquired various features using the obstacle recognition sensor and the heat detection sensor, we improved the Arduino. The user who can control the robot's Android mobile phone will detect the obstacle first and then detect the obstacle and detect the terrorist by means of the obstacle recognizing sensor.

As a result, the main purpose of designing this prototype of the robot is to take precautions against the terrorist attack on the military field. This robot can be developed using much higher quality materials.

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