

# SMARTPHONE CONTROL ROBOTS THROUGH BLUETOOTH

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## ABSTRACT

New research is going towards mobiles and robotics concerns that mobile control robots and concerns in the communication technology that connect mobile with robots. This paper describes how to control a robot using mobile through Bluetooth communication, some features about Bluetooth technology, components of the mobile and robot, how user can control the robot whether that user controlled robot directly or create path for robot are also represented.

**Keywords:** *Smartphone – Mobile – Robotics - Bluetooth – Symbian OS.*

## 1. INTRODUCTION

Robots these days are widely used to do jobs that need high accurateness, and they are used in situations that are dangerous on humans, like defusing bombs. [1] Robotics is concerned with the study of machines that can displace human beings in implementing processes, in physical activity and decision making. [2] Robotics can defined as the field of computer science and engineering that is concerned with building robots or it can say devices that can move and interact in their environment. [1]

Study of robots was based on three fundamental laws; first one that robot does not cause injure to humans, or cause any kind of harm. Second one, robot must comply with the orders given by humans of course take in mind the first law when comply with the order. Last one, robots must shelter its occurring, take in mind first and second laws. [2] Smartphone or mobile consider these days a very important device in our life. Majority of people are used mobiles in their life even sometimes they can't do they work without mobiles. Mobiles are developed every day, every day there is a new model that include new features.

It is important to control robots via new technologies in an easy way such control it by using mobiles through Bluetooth connection. This feature can give users many benefits like it is possible to control any machine in the building via mobile.

## 2. SYMBIAN OS TECHNOLOGY:

Symbian OS is an operating system that is designed especially for data enabled mobile phones. Symbian OS designed to be flexible and it can be used on devices with different user interfaces. [3]

Symbian OS is the advanced open operating system licensed by the world's leading mobile phone manufacturers. Symbian OS combines the power of an integrated applications environment with mobile telephony, bringing advanced data service to mobile users. Compact enough to fit in the memory of a mobile phone, and it was planned from the beginning to be a full operating system in terms of functionality. It includes a robust multi-tasking kernel, integrated telephony support, communications protocols, data management, advanced graphics support, the lower levels of the GUI framework, and application engines. [4]

Symbian OS enables mobile phones to be a platform for deployment of applications and services developed in a wide range of languages and content formats. With a flexible and modular implementation, Symbian OS provides a core set of applications programming interfaces and technologies that are shared by all Symbian OS phones. It is based on micro kernel architecture and implements full multi-tasking and threading. System services such as telephony, networking middleware and application engines all run in their own processes. The operating system has been designed from the ground up with mobile devices in mind, using advanced object oriented techniques, leading to flexible component based architecture. [5]

## 3. BLUETOOTH:

Bluetooth is a wireless technology in a short-range communications system that aims to replace cables connecting portable. Bluetooth has many features like robustness, low power, and low cost. [6] . Bluetooth technology was designed firstly to support simple wireless networking devices, including cell phones, wireless headset, wireless

mice, and PDA's. It is worth to mention that Bluetooth cover short distances. Bluetooth devices generally communicate at less than 1 Mbps. [7]

Bluetooth requires a low cost transceiver chip to be included in devices. The maximum range for Bluetooth is 10 meters and this is one of Bluetooth drawbacks and this limitations caused by its high frequency. [8]

#### 4. USING SMARTPHONE TO CONTROL ROBOTS:

The basic idea that will show is how to use Smartphone instead of PC's to control various applications that need high computational power which typical micro controls can't perform, and one of these applications is the robotics field. Powered by 32 bit Symbian OS, the series 60 Smartphone will actually act as the robots main brain, where all complex and heavy calculations, data storage and manipulation will be carried out as fully object oriented C++ based Symbian OS. The Smartphone will connect to the robot using a Bluetooth connection that carries signals between the two ends.

This experiment will have to modes; the first is direct control mode which the robot will directly respond to the user commands of movements and directions, while the other mode is to build a complete robotics system that can move in an area while interacting with the environment and adopting new changes of obstacles on its way.

In direct drive mode (DDM) the user sends only the movement directions to the robot which are move forward, break, turn left and turn right. The user can switch to map based mode (MBM) and vice versa. MBM allow user to draw a map in which the user define start point, end point and obstacles then the system will calculate the shortest path between the start position and the target.

The system aim to control robots using mobiles through Bluetooth connection, give the user full control of the target in an easy way, it allow to use one of the two modes (DDM and MBM) and make it possible to control any machine using mobile through Bluetooth connection.

##### 4.1 THE DIRECT DRIVE MODE (DDM):

The DDM is the mode of controlling the robot directly by sending the movements directions to the robot by pressing the arrows on the Smartphone keypad, for example the user wants the robot to move forward, the user press the **Up Arrow**, the robot will start moving forward, this command is applied by sending order to the robot via the connection, the robot receive the command, analyze it and then apply the corresponding movement.

##### 4.2 THE MAP BASED MODE (MBM):

The MBM is the complex mode of controlling the robot, by this mode, the robot can find the shortest path from defined start position to target point by avoiding all obstacles defined by the user or found while moving.

In this mode, the system can handle a map of 15x15 (according to the mobile screen size) area elements; the actual space of each block can be defined easily by robot hardware system.

##### How does MBM work?

Initially, the user will choose a target point to be reached, then presses the command that starts the search function, where the system will search for the optimum path in the map.

The idea is to choose the least traveled distance between start and target points. Such algorithm needs weights to be assigned to the nodes (the area elements) that indicate the distance. The problem was that every time the target is changed the weights changes too, thus the program evaluates the node weights at each search. The following listing shows the algorithm of assigning node weigh

##### **Algorithm: Assigning temp weights to nodes**

```

Set search node to target node.
Set the TempWeight to 1.
L1:      // reference to come back here and start again from here
Check an unchecked adjacent node.
If start node then return.      //reached the start node (finished)
Mark the node as checked.
Set its weight to TempWeight.
If all adjacent nodes are checked then
{
Increment TempWeight.
Set search node to a sub node.
If all sub nodes are checked then return.
}
Repeat L1.

```

The algorithm begin search about the path from target to start position not from start position to target, target take weight = 0, algorithm put weight =1 to nodes that around the target (horizontal and vertical nodes not diagonal nodes because robot walk in horizontal and vertical way and not walk in diagonal way in this experiment), then it puts weight = 2 to the nodes that around the nodes that take weight = 1 also horizontal and vertical nodes, algorithm will check if reach the start node then finish, if not it will book nodes and gives it weight = 3, then the algorithm will increment the weight and gives this new weights to the nodes. The algorithm will check if all nodes are checked and not reach the start node then there is no path, if not all nodes are checked it will repeat from L1.

Figure1 below shows the result of applying this algorithm on the map, the yellow square is the robot location and the green is the target. The weight inside the nodes indicates the number of nodes to be traveled to reach the target from this node. Blank nodes are unchecked nodes since the algorithm found the start point before it reaches them; hence no need to assign the rest of the map.

	5	4	5		
5	4	3	4	5	
4	3	2	3	4	5
3	2	1	2	3	4
2	1	0	1	2	3
3	2	1	2	3	4

Figure1

**Real practice for MBM**

**Setting the Start Point:** Setting the start point can be easily done by pressing on the mobile Keypad.

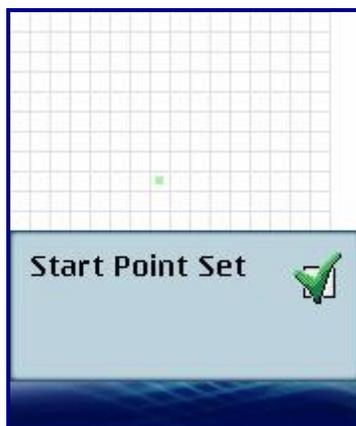


Figure2 (Setting start point)

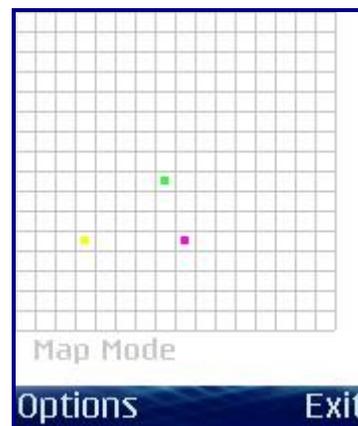


Figure3 (Start Point Set)

Figures above show the setting of the start point on a new position.

**Setting the Target Point:** Setting the target point is same of setting the start point but by pressing another key on the mobile keypad.

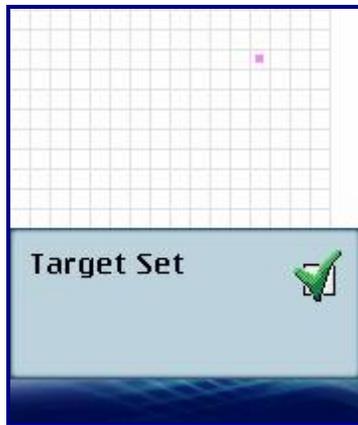


Figure4 (Setting Target point)



Figure5 (Target Point Set)

Figures show the target on the new position.

In both cases, setting start point or target point if the user tried to assign the target or the start to a block that contains obstacle a message will appear informing that an Obstacle is exist

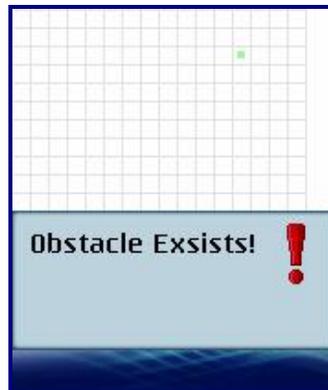


Figure6 (Assign Error)

**Setting the Obstacles:** Obstacles can be defined by pressing a key on the mobile keypad.

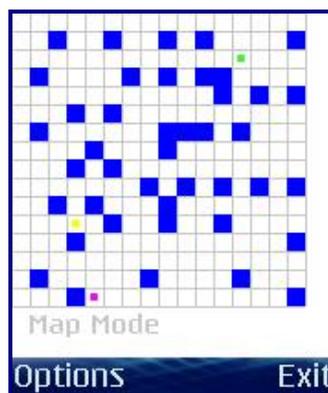


Figure7 (Setting Obstacles)

Figure7 show the map after assigning the obstacles, each obstacle is denoted by a blue filled rectangle.

After assigning the start and target points and the Obstacles, the user can find the path by pressing the Green Call Button on mobile keypad.



Figure8 (Path Found)

Figure8 shows that the system has successfully found the path and marked it with Red rectangles.



Figure9 (No Path Found)

Figure9 shows that an error message appears to the user in case that there was no path between the start and the target because Obstacles is blocking all possible paths.

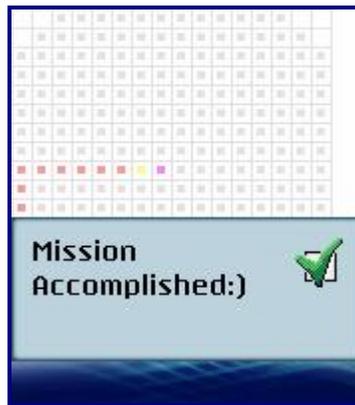


Figure10 (Target Reached)

Figure10 Shows a messages to confirm that the Robot has successfully reached the target.

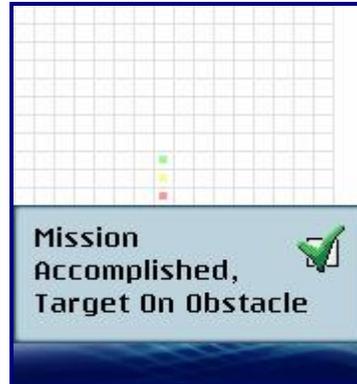


Figure11 (Target on Obstacle)

Figure11 Shows a message to confirm that the Robot has successfully reached the target but the target was on an Obstacle.

## 5. CONCLUSION

The experiment has integrated a high performance Smartphone with robotics and utilized the Bluetooth technology as a fast, secure and reliable connection between them.

By this experiment it found that it is possible to control any hardware via the same hierarchy that mentioned. It allows opening a door, switching on a car and activating any machine.

In future it is possible to add GPS adapter to the robot to make it possible to identify the actual position of the robot, also add voice command instead of keypad.

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