METAL DETECTION ROBOT

INTERNSHIP REPORT ON EMBEDDED SYSTEMS

Submitted by

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Under the Esteemed Guidance of

Ms. MOUNIKA

(ECE Faculty at ECIL)

In partial fulfillment of the Academic Requirements for the Degree of

BACHELOR OF TECHNOLOGY

Electronics & Communication Engineering

MALLA REDDY ENGINEERING COLLEGE FOR WOMEN

(Autonomous Institution-UGC, Govt. of India)

Accredited by NBA & NAAC with 'A' Grade

NIRF Indian Ranking, Accepted by MHRD, Govt. of India | Rank Band (6th-25th) by ARIIA, Accepted by MHRD, Govt. of India

Approved by AICTE, Affiliated to JNTUH,ISO9001:2015CertifiedInstitution

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2nd Rank by CSR, National Ranking-Top 100 Rank band by Times News Magazine, 141 Rank by India Today-Best Engineering Colleges of India Rankings-2020.

Maisammaguda, Dhulapally, Secunderabad, Kompally-500100.

2022-2023

Internship Report

On

"EMBEDDED SYSTEMS"

Submitted in partial fulfillment of the Requirements for theaward of Degree of Bachelor of Engineering

In

Electronics and Communication Engineering

TENTU ALEKHYA (19RH1A04M7)
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EMBEDDED SYSTEMS INTERNSHIP AT ELECTRONICS CORPORATION OF INDIA LIMITED(ECIL)

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Maisammaguda, Dhulapally, Secunderabad, Kompally-500100.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the Project Work entitled "**METAL DETECTION ROBOT**" is carried out by **T.Alekhya (19RH1A04M7), R.Navishna (19RH1A04K0), S.Manjusha (19RH1A04K7)** is a bonafide student of Malla Reddy Engineering College For Women has submitted in partial fulfillment of the requirements (**EMBEDDED SYSTEMS Internship Project**) for the award of degree of **BACHELOR OF TECHNOLOGY** in Electronics and Communication Engineering, Jawaharlal Nehru Technological University, Hyderabad during the academic year 2022-2023. The Internship Report has been approved as it satisfies the academic requirements with respect of the Project Work prescribed for said degree.

Head of the Department

Dr. K. Sudhakar

ACKNOWLEDGEMENT

While presenting this EMBEDDED SYSTEMS Project on "**Metal Detection Robot**", we feel that it is our duty to acknowledge the help rendered to us by various persons.

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Any task is of great enormity and it cannot be accomplished by ana individual without support and guidance. I am grateful to a number of individual whose professional guidance and encouragement has made this project completion a reality and a great learning experience.

With Regards and Gratitude,

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ABSTRACT

The main objective of this project is to develop a Metal Detector Robot which is a machine that can be controlled with an Android-based smartphone. This machine is used to detect the presence of metal, especially landmines. This is important because landmines can cause injuries and fatalities. The old way of detecting landmines, which is straight forward, is very risky because someone could step on one by accident. In this research, the robot was equipped with a metal detector. This metal detector works based on coil induction. When the robot is near metal, the machine will start to buzz and the LCD will show the frequency of the metal that was detected. The robot can move up to 15 meters away from the detector head and the radius of the detection is effective up to 88 millimeters.

INDEX

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION ABOUT THE PROJECT

We have many different materials, including metal and non-metal materials. Non-metal materials that we know include things like wood, plastic, and other materials that are often used in everyday life. In general, metals are divided into ferrous metals and non-ferrous metals [1]. Things that are made of metal, like tools and weapons, are usually used to conduct electricity, cook food, and make jewelry. Military technology includes things like mines, which are explosives that have special physical and chemical properties.

Robots are machines that can do jobs that are difficult or dangerous for people to do. For example, a metal detector is a type of robot that can detect mines buried in the ground. People use metal detectors to find mines, but they are also vulnerable to being harmed by them. Some robots are designed to have arms, so they can do things like follow certain colors. This means that robots are becoming increasingly important in the field of mines.

1.2 LITERATURE REVIEW:

Research on metal detection robots has been carried out by several researchers to produce a metal detection robot design as desired . Metal detection robot studies were developed based on a microcontroller, to make programming easier. Among them is a metal detection robot based on a microcontroller. Several recent studies in robot design are based on Arduino or some research based on Android. The results of his research describe the application of using an inductive proximity sensor in a metal detector robot based on a 328 microcontroller. The way this robot works is controlled by a wireless remote radio frequency of 315 Mhz, previously a metal detector robot has installed a receiver with a signal that comes out of the wireless remote . The previous metal detector robot was also entitled metal detector for the PLC-based food industry in 2011 . Currently, PLC-based control is still widely used in industries whose equipment uses large power equipment, including in the food industry.

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The addition of a metal sensor will make it easier to detect food if it is accidentally mixed into food . The purpose of this research is to design an android-based metal detection robot, which can be controlled by a smart phone connected to Bluetooth, with the reliability of being able to detect both ground and underground metals.

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CHAPTER 2

2.1 INTRODUCTION TO EMBEDDED SYSTEMS

Embedded System

As its name suggests, Embedded means something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor based system which is designed to perform a specific task. For example, a fire alarm is an embedded system; it will sense only smoke.

An embedded system has three components −

It has hardware.

It has application software.

It has Real Time Operating system (RTOS) that supervises the application software and provide mechanism to let the processor run a process as per scheduling by following a plan to control the latencies.RTOS defines the way the system works. It sets the rules during the execution of application program. A small scale embedded system may not have RTOS.

So we can define an embedded system as a Microcontroller based, software driven, reliable, real-time control system.

2.2 CHARACTERISTICS OF EMBEDDED SYSTEMS

- Intelligence: Combination of algorithms and computation, software and hardware.
- Connectivity
- Dynamic Nature
- Enormous Scale
- Sensing
- Heterogeneity
- Security

2.3 APPLICATIONS OF EMBEDDED SYSTEMS

We are living in the Smart World. You are surrounded with many Embedded system products and your daily life largely depends on the proper functioning of these gadgets. Smart Television, Mobiles, Laptops, Robots, Washing Machine or Microwave Oven in your kitchen, Card readers, Access Controllers, Palm devices of your work space enable you to do many of your tasks very effectively. Apart from all these, many sensors embedded in your car take care

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of car operations between the bumpers and most of the times you tend to ignore all these embedded systems.

- Wearable's
- Smart Home Applications
- Health Care
- Smart Cities
- Agriculture

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CHAPTER-3

HARDWARE DESCRIPTION

3.1 Schematic of metal detection robot

This process describes the robot scheme to be built. This scheme is made to simplify the design process because the grooves or cable connections have been validated using the proteus software.

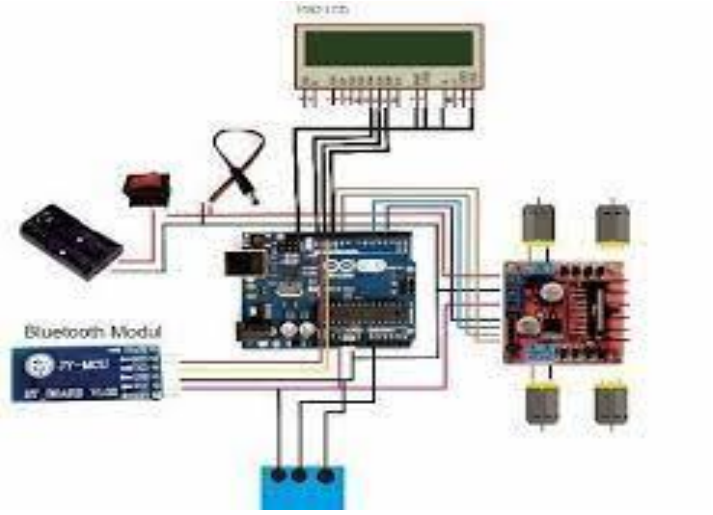

Figure 1. Scheme of metal detection robot

Robot Design

1) Frame

The robot is designed using 2 frames, both of which are made of acrylic material with dimensions of 250 mm x 140mm x 3mm, as shown in Figure 2.

2) Gearbox (DC motor)

The drive used for this robot is to use a DC motor [14]. The use of a gearbox is needed to make efficient space on the chassis and change the shaft position of the DC motor because by using a gearbox, a dc motor that should be placed horizontally to distribute its rotation to the wheels can be positioned vertically with a fixed axle.

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3) Metal sensor

This component is the most important part in the design of a metal sensor robot, with this component where the detected metal can be detected. For this study, researchers used metal sensors with the following specifications [7]. (a) Detection distance: 0-8mm; (b) Object of detection: Metal (Iron, Aluminum etc.); (c) Working voltage: 10-30V DC; (d)current Output: 300mA; (e) There are indicators: Yes (Red); (f) Working temperature: -25 to +70 C; (g) Size: 18x18x36 mm; (h) Cable length: 1.5m; (i) 34mm x 18.2mm x 17.5mm.

4) Buzzer

This component is a component that converts electricity into sound. The buzzer will output the metal sensor robot. This tool will notify by emitting a sound when the metal sensor detects the presence of metal.

5) Battery

This component is the power supply in metal detection robots. The battery used is a battery with a current of 9V, this battery is considered sufficient to supply all the electrical needs of the metal sensor robot, from starting to turn on 4 DC motors, motor drivers, Arduino, metal sensors, buzzer, and LCD dot matrix.

6) Arduino

Arduino is a board microcontroller, this tool will fully control the robot system from input and output according to what is ordered or programmed on the computer.

7) Motor driver

The motor driver is used to control the direction of rotation and speed of the DC motor which is the main driving force of the robot. This motor driver will be controlled using a microcontroller by digital input data.

8) LCD dot matrix

Character numbers, letters, and symbol characters can be displayed on this device, with small current consumption.

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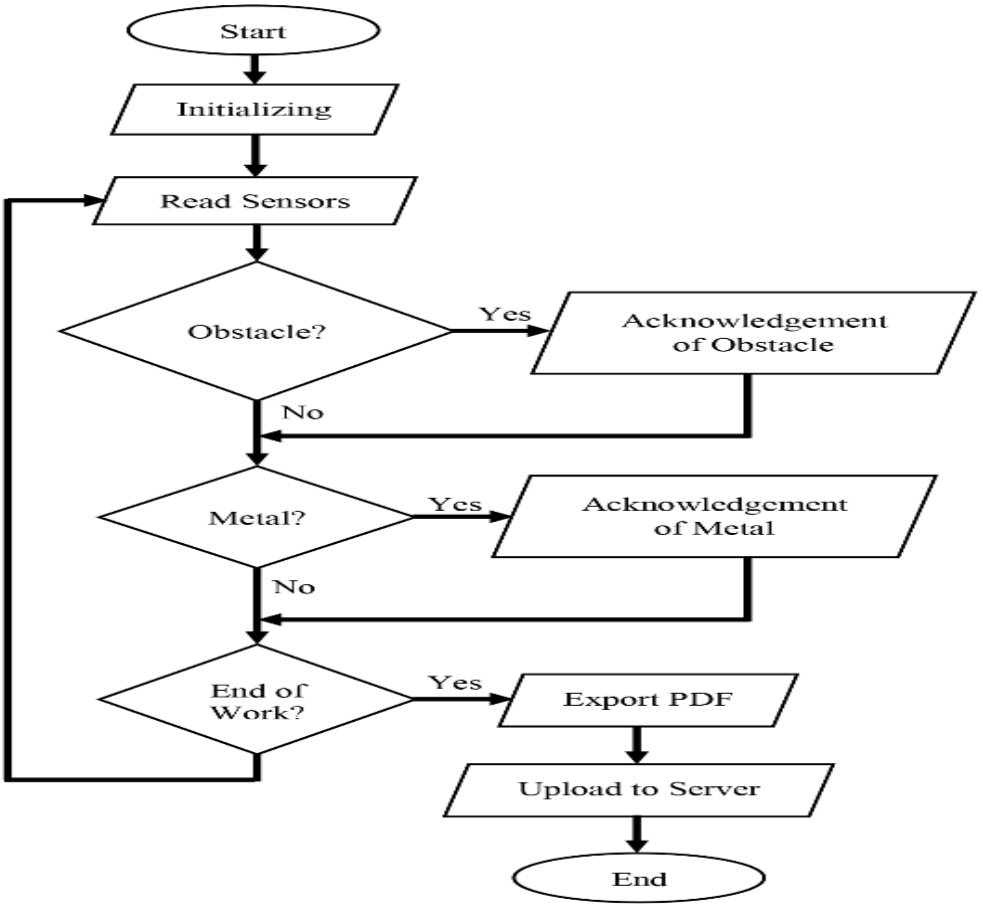
BLOCK DIAGRAM



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CHAPTER 4

SOFTWARE DESCRIPTION

4.1 Getting started with ARM LPC2148 using Keil uVision IDE

There are various development environments available in the market for ARM processors.

Some of these are mentioned below:

- CrossWorks for Arm
- Keil µVision
- IAR Embedded Workbench

We will see how to install and set up the µVision IDE by Keil.We will see the steps that need to be followed for installing this software correctly.When this is done, we will set up the environment for LPC2148 and write a basic code for LED blinking.

Downloading and installation

Follow the steps given below:

1. Download the MDK-lite (Microcontroller Development Kit) by Keil from their website. Here is the link to the page from where you can download this : http://www2.keil.com/mdk5/install

Click on **Download MDK-Core**.

Install the software by following the simple instructions provided during the installation process.

2. The new version µVision5 does not support many of the devices that were supported in the older versions yet. LPC2148 is one of the devices that are not supported. Hence, we need to add this device after successfully installing µVision5.

To do this, go to the following link and download the executable file for Legacy Support for ARM7, ARM9, and Cortex-R: http://www2.keil.com/mdk5/legacy

Download the Legacy support for the version of MDK downloaded and installed.

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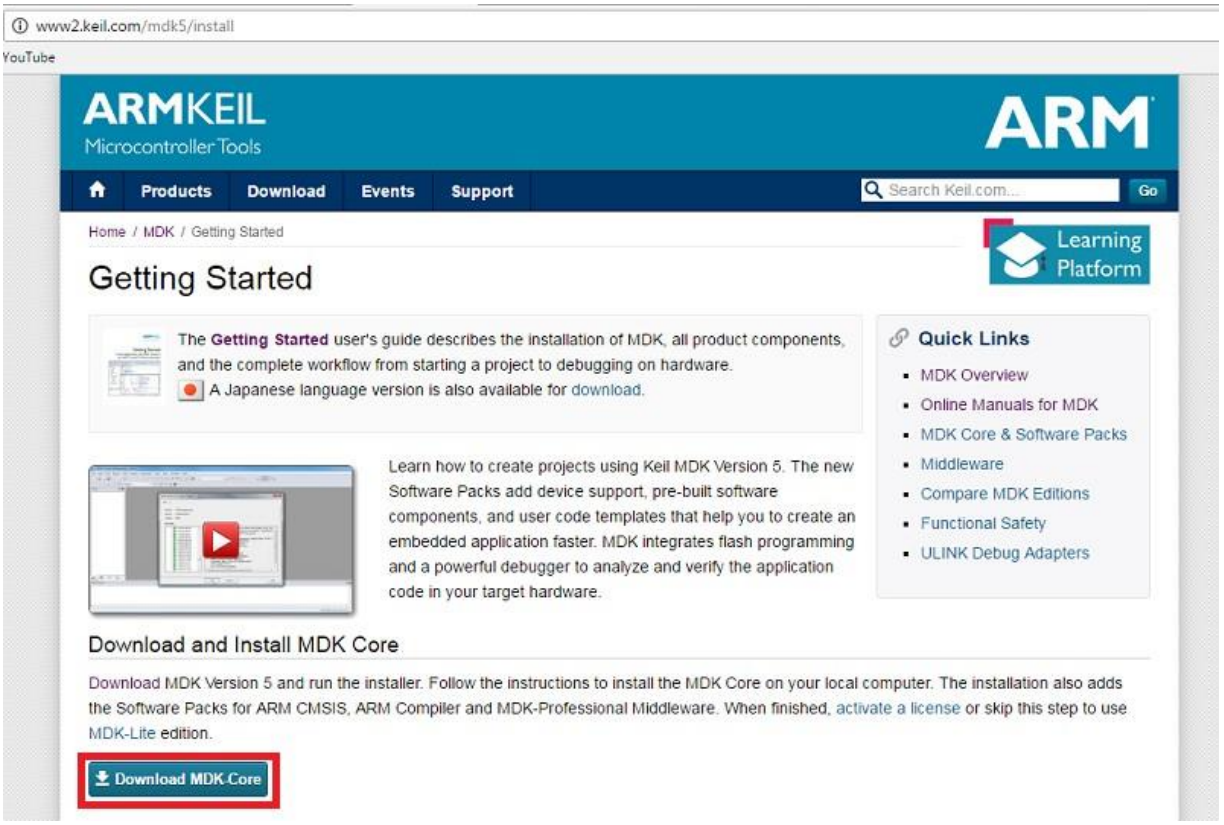

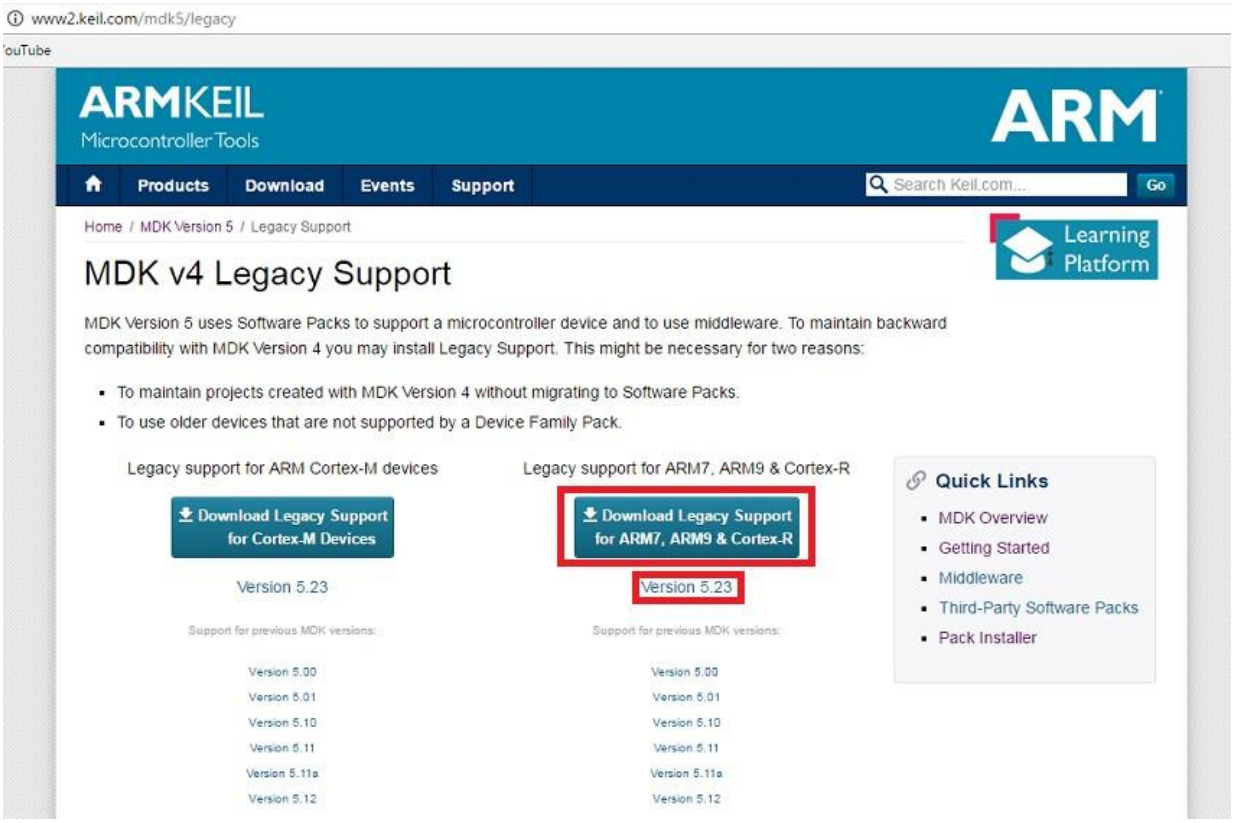

Install the executable file that will be downloaded. Follow the simple instructions provided during the installation process.

When the above described steps are completed, we will have the IDE installed and ready to use

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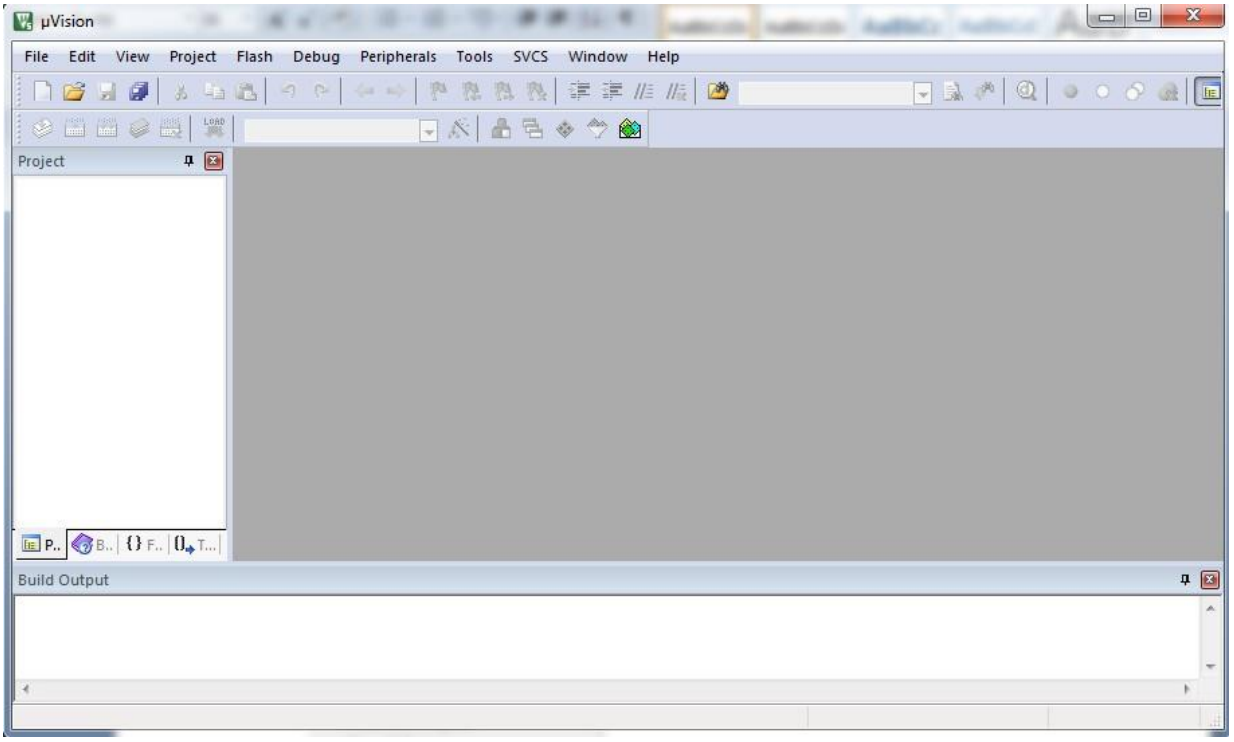
with support for the device we intend to use, i.e. LPC2148.

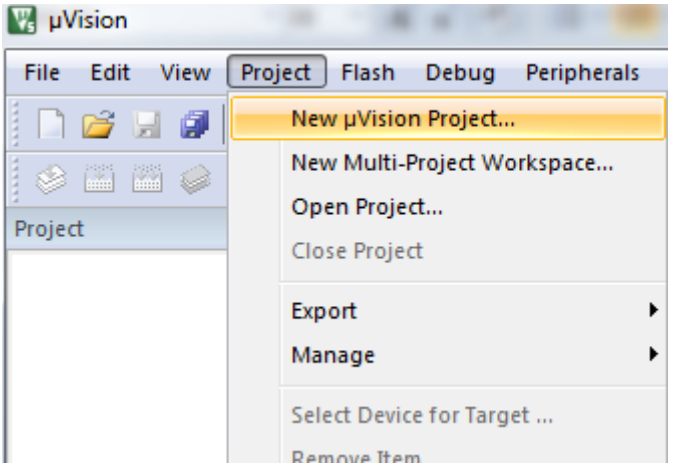
Using µVision IDE

We will create a simple LED blinking project. Following are steps which show how to create and built project using the Keil uVision IDE:

1. Open Keil µVision from the icon created on your desktop.



2. Go to the **Project** tab. Select New **µVision Project** from that menu.



3. **Create New Project** window will pop up. Select the folder where you want to create the project and give a suitable name to the project. Then click on **Save**.

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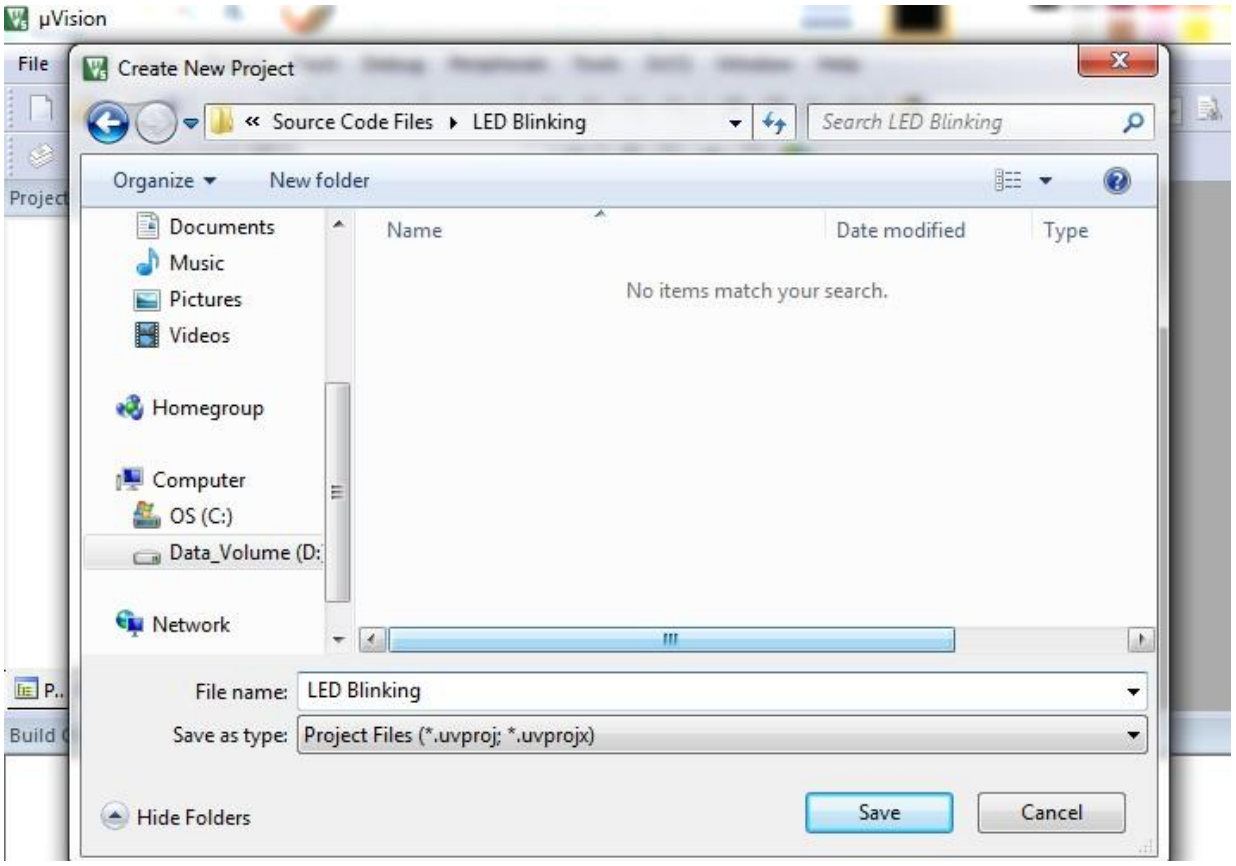
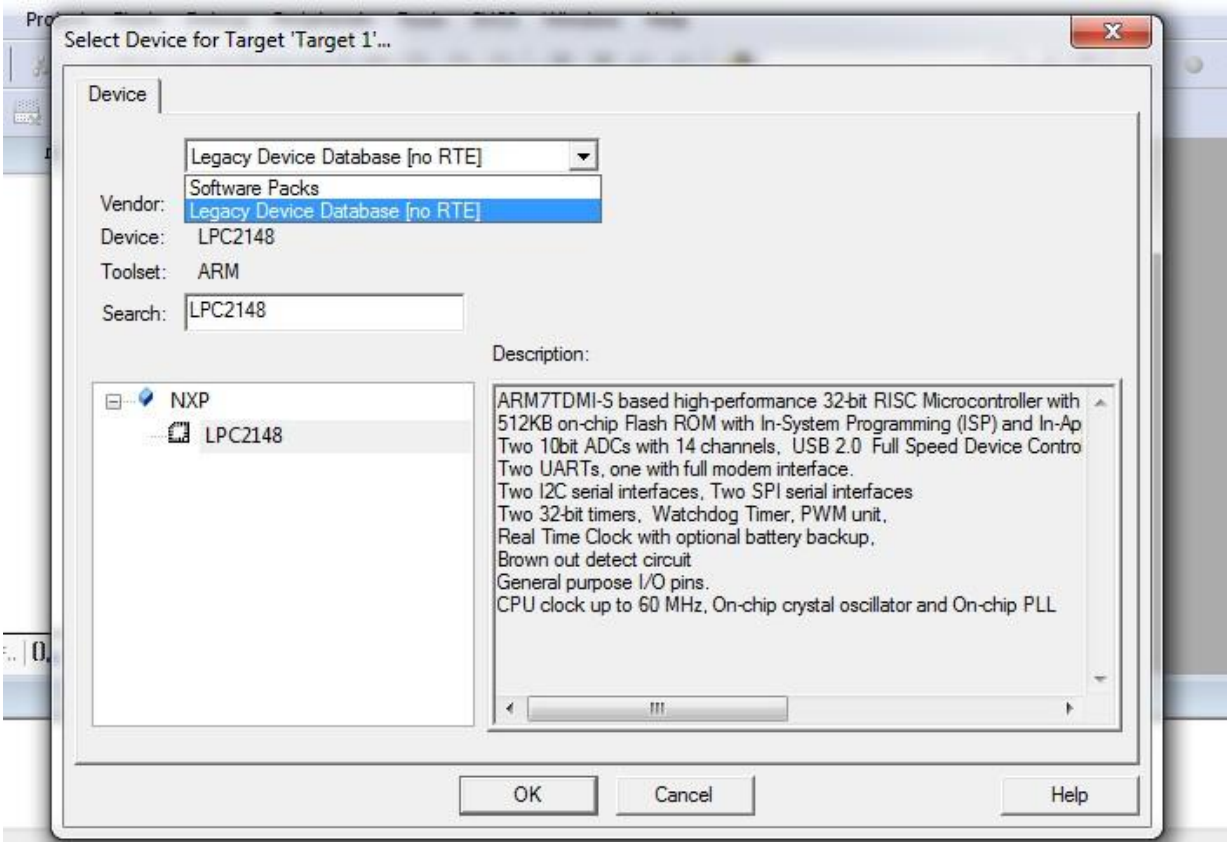


4. **Select Device for Target: 'Target1'** window will pop up next. It has a select window to choose between Software Packs or Legacy Device Database. As LPC2148 is in Legacy Device Database, choose Legacy Device Database.



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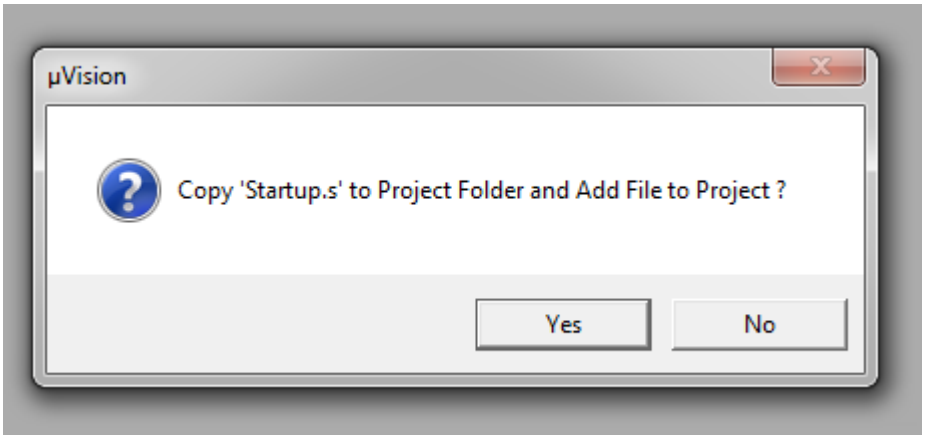
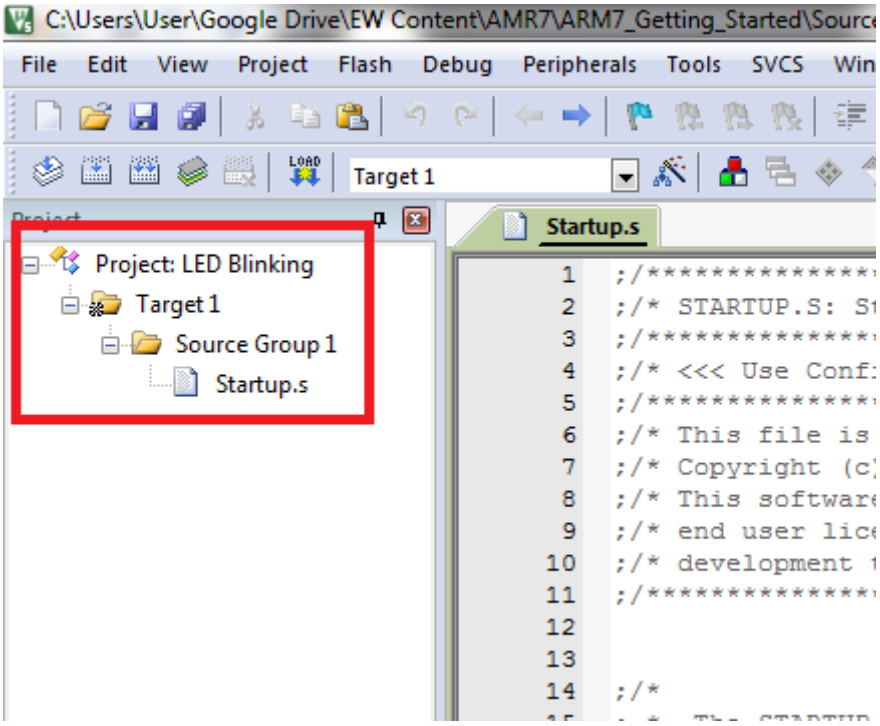
Type in LPC2148 in search and select the device under NXP with the name LPC2148 and click on OK.

5. A window will pop up asking whether to copy Startup.s to the project folder and add a file to the project. Click on Yes.



6. The project name and its folders can be seen on the left side in the project window after the previous step is completed as shown below.



7. Now go to File tab and add New file from the menu.

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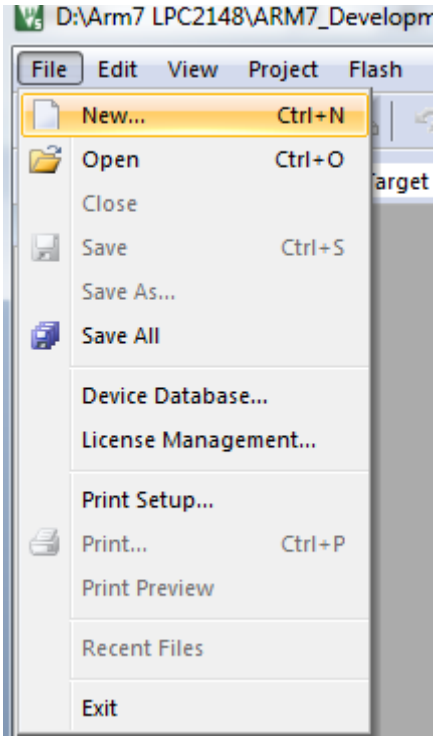
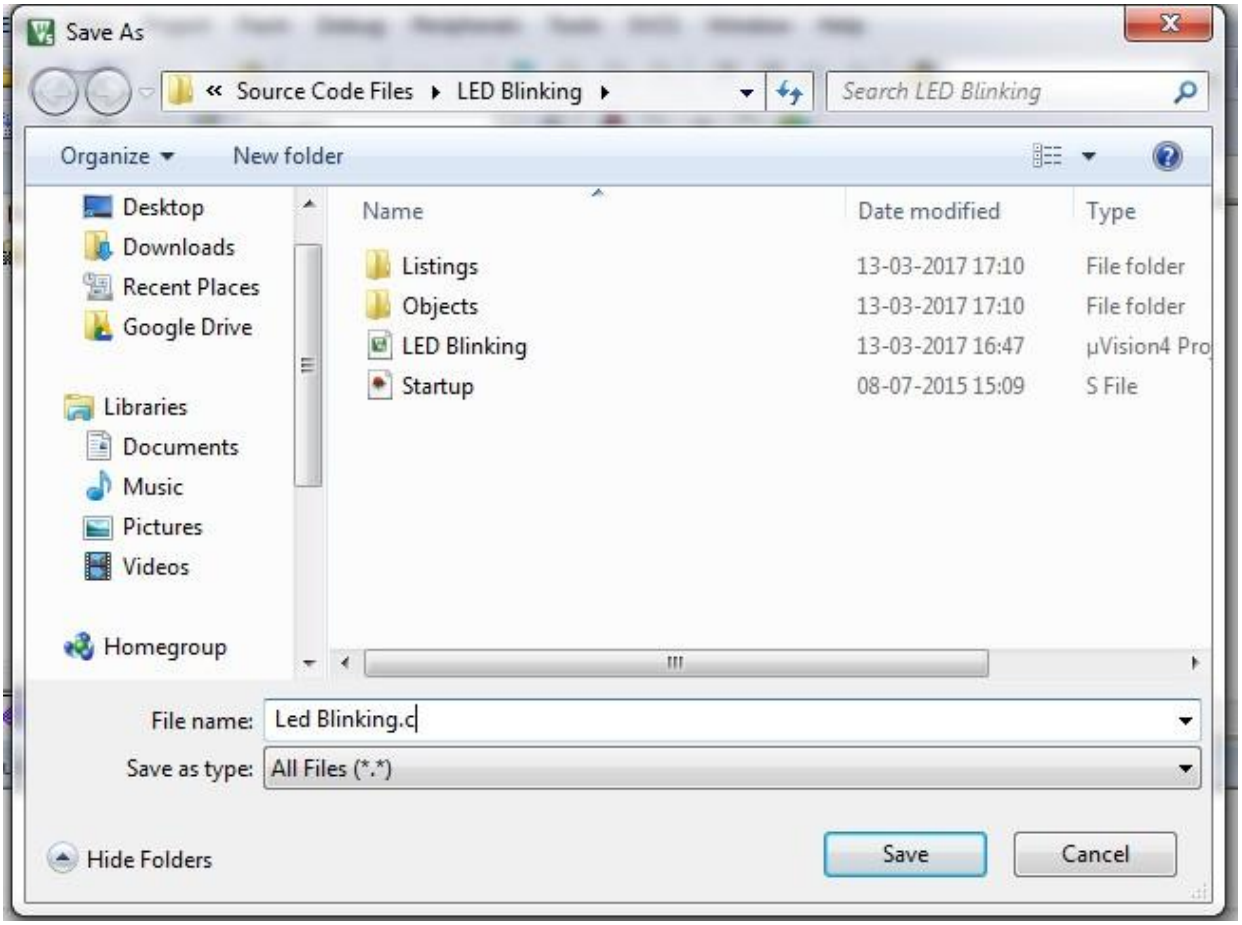


8. Save the file from the previous step with a specific name. Add .c extension to the file name.



9. Add this file to Source Group folder in the project window by right clicking on Source Group1 folder and selecting Add Existing Files to Group ‘Source Group1’.

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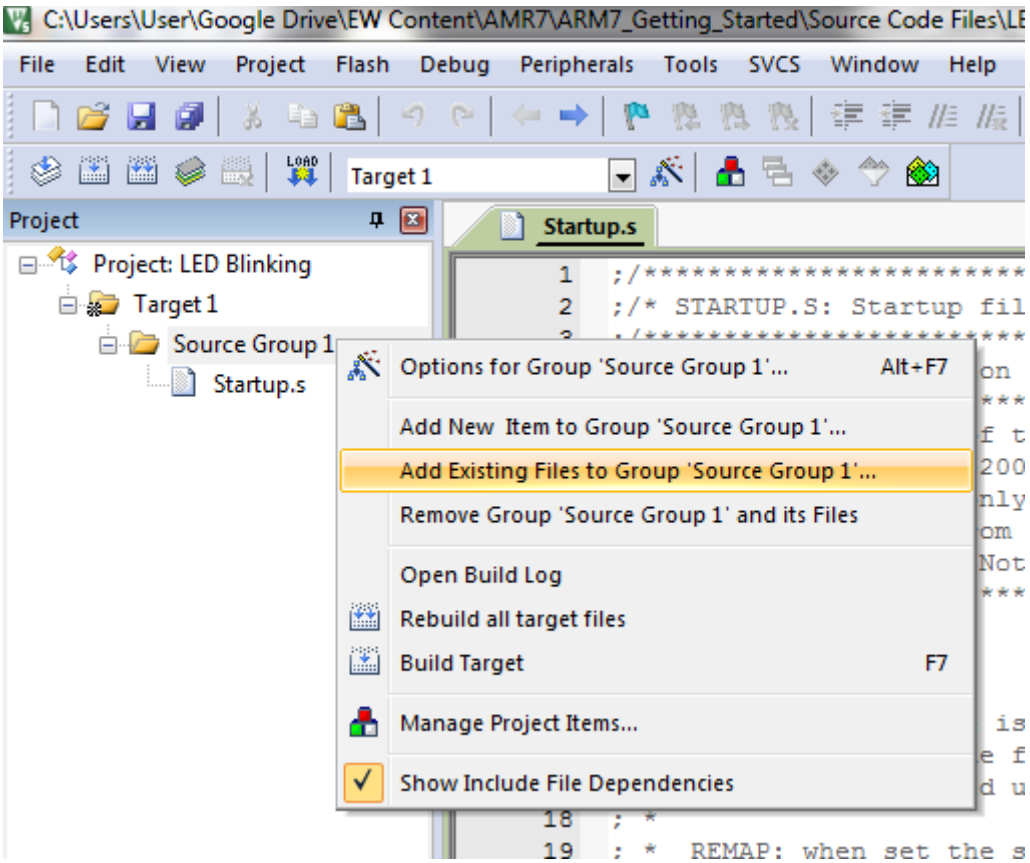

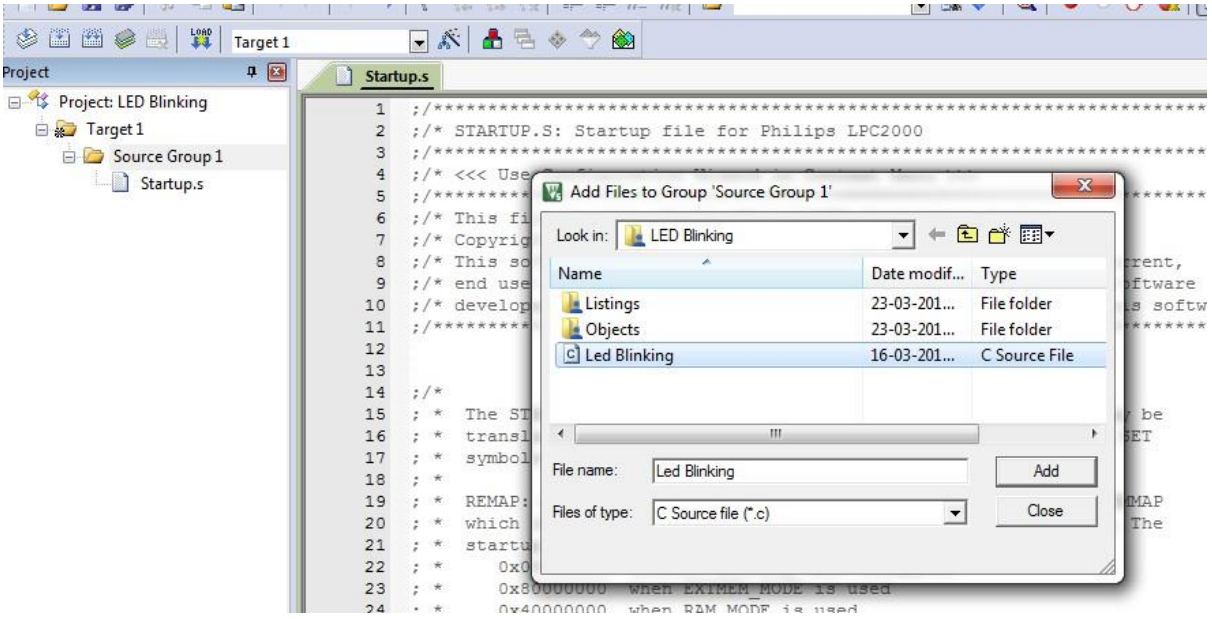

Select the previously saved file from the window that pops up and add it to the Source Group1. In our case, LED Blinking.c

10. Now click on the Options for Target 'Target1'... symbol shown in red box in the image below or press Alt+F7 or right click on Target1 and click on Options for Target 'Target1'....

Options for the target window will open. Go to the Output tab in that window. Tick '√' Create HEX File option. We need to produce a HEX file to burn it into the microcontroller.

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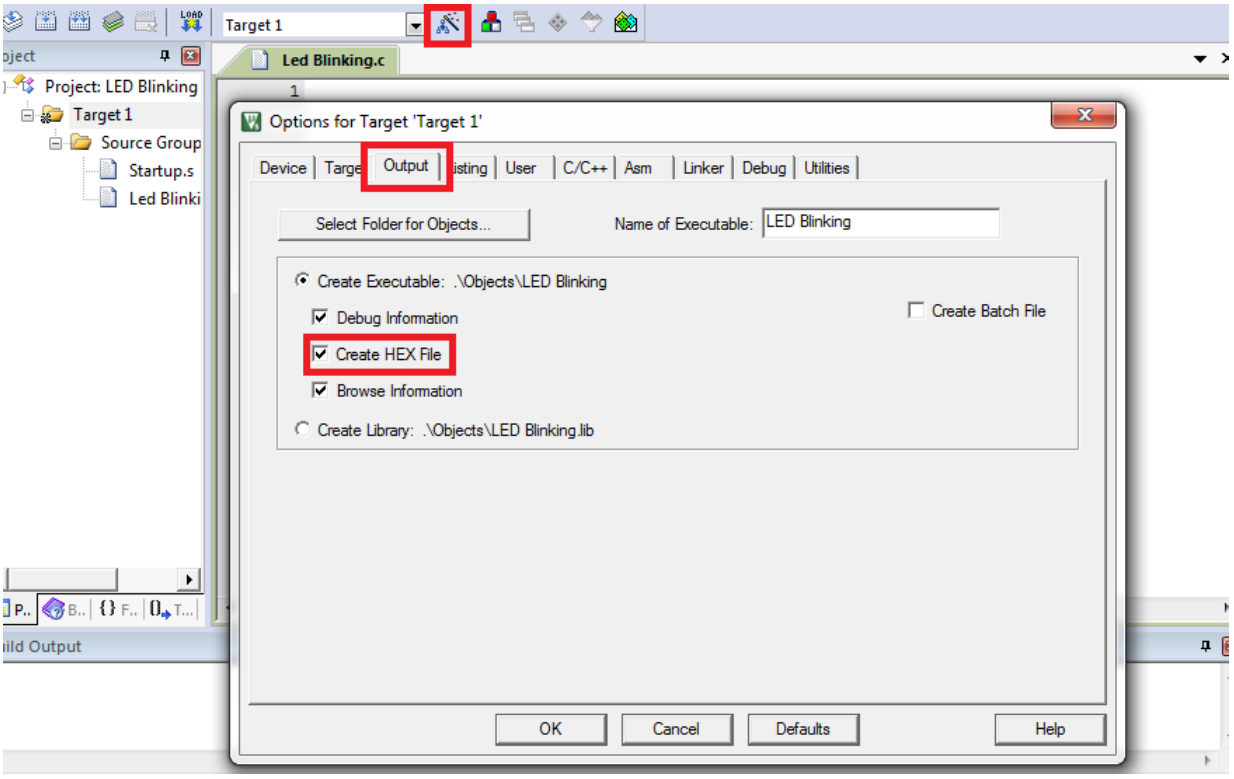
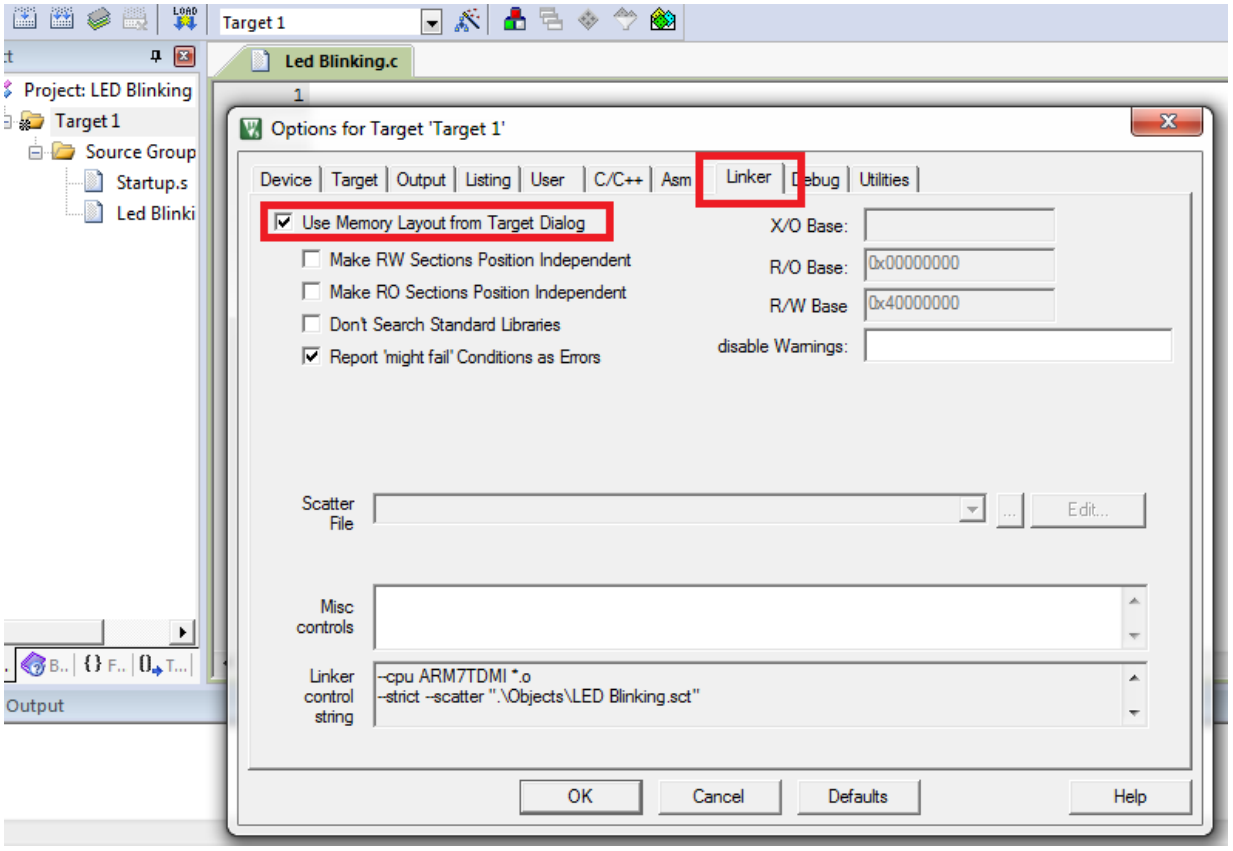


In the options for target window, go to the Linker tab. Select the Use Memory Layout from Target Dialogue option.



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Then click on OK.

11. Now write the code for LED Blinking.

```
/*
  LED Blinking on LPC2148(ARM7)
  http://www.electronicwings.com/arm7/getting-started-with-arm-lpc2148-using-keil-uvision-ide
*/

#include <lpc214x.h>
#include <stdint.h>

void delay_ms(uint16_t j) /* Function for delay in milliseconds */
{
   uint16_t x,i;
        for(i=0;i<j;i++)
        {
   for(x=0; x<6000; x++);    /* loop to generate 1 millisecond delay with 12MHz Fosc. */
        }
}

int main(void)
{
        IO0DIR = 0x000000FF;        /* Set P0.0 to P0.7 bits as output bits by writing 1 in
IO0DIR register corresponding to those bits. */
        while(1)
        {
                IO0PIN =  IO0PIN | 0x000000FF; /* Make P0.0 to P0.7 HIGH while keeping
other bits unchanged. */
                delay_ms(300);
                IO0PIN = IO0PIN & 0xFFFFFF00; /* Make P0.0 to P0.7 LOW while keeoing
other bits unchanged. */
                delay_ms(300);
        }
}
```

12.Once the code is written, Build the code by clicking on the button shown in red in the image below. You can also build the project from the Build Target option in the Project tab or by pressing F7 on the keyboard.

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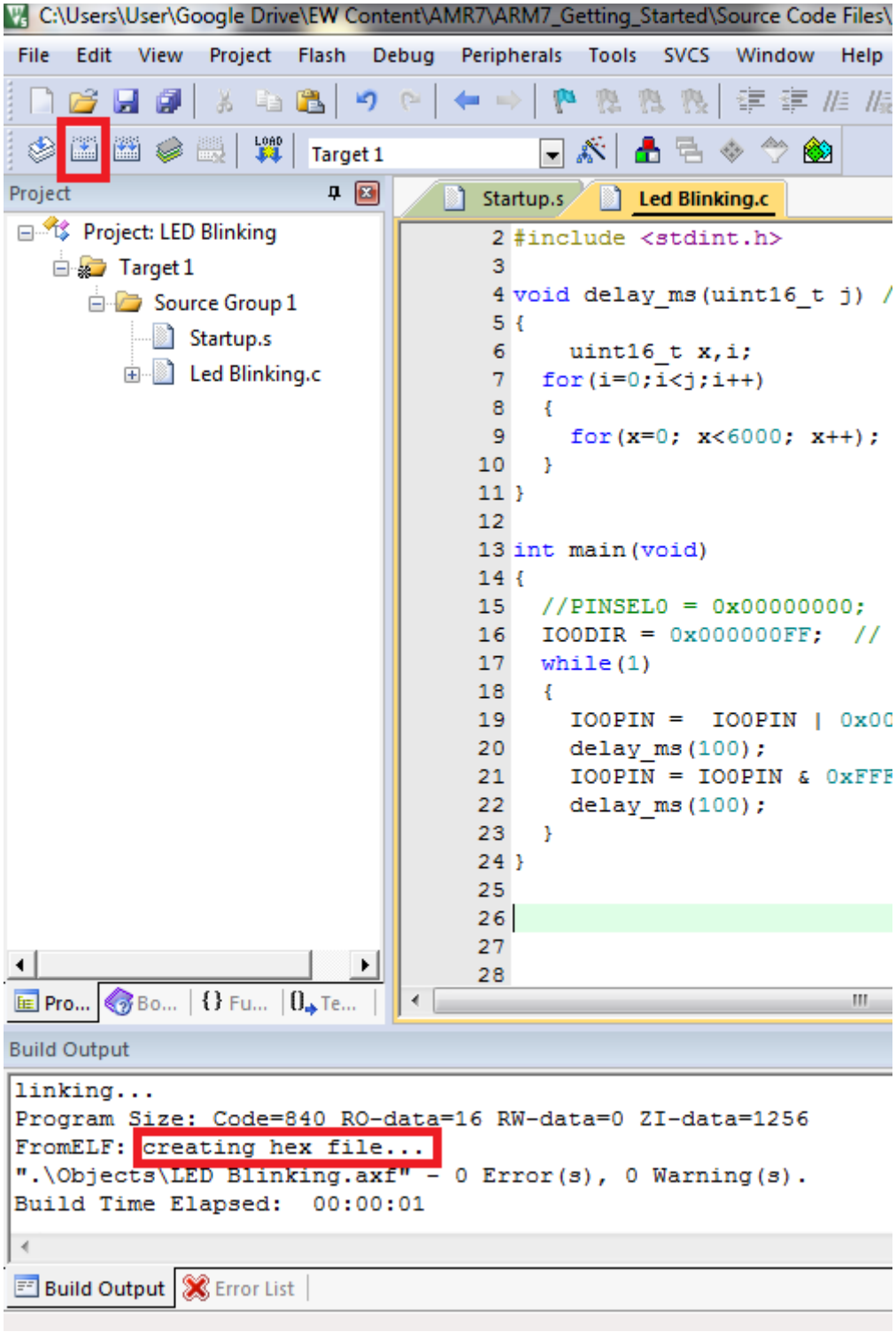

You can see creating hex file ... in the Build Output window as shown in the image.

12. Once the project is built, a hex file is created in the Objects folder inside the folder of your project. Use Flash Magic software to burn this hex file in your microcontroller.

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CODE

```
        int led=13;
int mtr00 = 8;
int mtr01 = 9;
int mtr10 = 10;
int mtr11 = 11;
int temp = 0, i = 0, x = 0, k = 0;
char str[100], msg[32];

void setup()
{
  Serial.begin(9600);
  pinMode(led, OUTPUT);
  pinMode(mtr00, OUTPUT);
  pinMode(mtr01, OUTPUT);
  pinMode(mtr10, OUTPUT);
  pinMode(mtr11, OUTPUT);
  digitalWrite(led, HIGH);
 delay(1000);

  digitalWrite(led, LOW);
}

void loop()
{
   for (unsigned int t = 0; t < 60000; t++)
  {
    serialEvent();
    if (temp == 1)
    {
      x = 0, k = 0, temp = 0;
      while (x < i)
      {
```

)

```
  while (str[x] == '*')
  {
    x++;
    while (str[x] != '#')
    {
      msg[k++] = str[x++];
    }
  }
  x++;
}
msg[k] = '\0';
 delay(100);
temp = 0;
i = 0;
x = 0;
k = 0;
if (!strcmp(msg, "front"))
{

  Serial.println("forward");
  digitalWrite(mtr00, HIGH);
  digitalWrite(mtr01, LOW);
  digitalWrite(mtr10, HIGH);
  digitalWrite(mtr11, LOW);
}
if (!strcmp(msg, "back"))
{

  Serial.println("backward");
  digitalWrite(mtr00, LOW);
  digitalWrite(mtr01, HIGH);
  digitalWrite(mtr10, LOW);
  digitalWrite(mtr11, HIGH);
}
if (!strcmp(msg, "left"))
{
```

)

```
        Serial.println("leftward");
        digitalWrite(mtr00, HIGH);
        digitalWrite(mtr01, LOW);
        digitalWrite(mtr10, LOW);
        digitalWrite(mtr11, LOW);
      }
      if (!strcmp(msg, "right"))
      {

        Serial.println("rightward");
        digitalWrite(mtr00, LOW);
        digitalWrite(mtr01, LOW);
        digitalWrite(mtr10, HIGH);
        digitalWrite(mtr11, LOW);
      }
      if (!strcmp(msg, "stop"))
      {

       Serial.println("robot stop");
        digitalWrite(mtr00, LOW);
        digitalWrite(mtr01, LOW);
        digitalWrite(mtr10, LOW);
        digitalWrite(mtr11, LOW);
      }
    }
  }

}
void serialEvent()
{
  while (Serial.available())
  {
    char ch = (char)Serial.read();
```

)

```
            str[i++] = ch;
        if (ch == '*')
        {
          temp = 1;

          delay(1000);
        }
      }
    }
```

)

CHAPTER 5
RESULT ANALYSIS
5.1 RESULTS

Testing the system input on the sensor connected to the microcontroller with output buzzer and LCD. The use of the buzzer is intended to determine the presence of detected metal, and the use of LCD as a display of the resulting voltage on each detected metal. The results of metal detector testing by placing metal above and below the ground areas in Table 3 and Table 4.

TABLE 3. Metal detector test results (metal placed on the ground)

Metal Type	Distancae (cm)	Buzzer	
		On	**Off**
Aluminium	0,5	✔	
	1	✔	
	1,5		✔
Iron	0,5	✔	
	1	✔	
	1,5		✔
Copper	0,5	✔	
	1	✔	
	1,5		✔

TABLE 4. Metal detector test results (metal placed on the ground)

Metal Type	Distance (cm)	Buzzer	
		On	Off
Aluminium	0,5	✔	
	1	✔	
	1,5		✔
Iron	0,5	✔	
	1	✔	
	1,5		✔
Copper	0,5	✔	
	1	✔	
	1,5		✔

ADVANTAGES

- Robots are used for in detecting the minerals present in the ground.
- These robots are used for detecting the bombs.
- These can be used in construction industry for locating steel bars present in concrete.
- They are used in airports and building security to detect the weapons.

APPLICATIONS

- Checkpoints in airports
- Schools
- Courthouses
- Prisons
- Military installations

CONCLUSION

Metal detectors can detect the presence of metal with a variety of metal types, aluminum, low carbon steel, and copper with a maximum detection distance of 1 cm. The reliability of the robot can move with a terrain slope of 300, using a 7.4V DC motor, 160-255 rpm rotation.

FUTURE SCOPE

Designing the integrated system which consists of a simple robot provided with the metal detector and using Bluetooth technology to communicate with its own software inside the computer. In the intelligent algorithm end, the robot can detect the obstacles in the front of its path, so if there is a multi-way in the navigation or searching area, the robot can identify the best way that has the lowest obstacles. Also, when the robot detects a particular metal, by an intelligent method the robot will discover the dimensions of such metal and analyse the results to present the largest area of the exposed metals. The robot will send the data to the computer, so the system will display the received data from the robot and analysed them immediately. The scope of the detection of metals depends on the sensitivity of the sensor type used. So, in the proposed detection robotic vehicle, the metal sensor can detect from 5 up to 7 cm underground flat surface. The sensor used can detect metals like aluminium, iron, and copper.

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