Title of script: Introduction to firebird-V robot

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| Slides | Narration |
| 01.  Title | * Hello Friends. * Welcome to the video tutorial on Firebird V Robotics Research Platform. * This platform is based on LPC 2148 microcontroller which belongs to ARM architecture based microcontroller family. * In this tutorial, we will **Introduce you to Firebird V robotics Research Platform**.  |  | | --- | |  |   **(press next)** |
| 02.  Agenda | * Now let us see the agenda for discussion in this tutorial is * We will discuss the major components that make a robotic system. Then we see various versions of firebird robotics research platform. We will then discuss the major components present in the firebird-v LPC 2148 based platform and hence understand the capabilities of the firebird platform   **(press next)** |
| 03.  Major Building Blocks of Robot | * So, what are the major building blocks or components needed for a designing a robot? **(press next)** * The first component is Sensor. So sensors are devices which allow the robot to sense the environment around it. Sensing devices can be used by robot to see if path in which it is moving is clear without any obstacle, or sensors can be used by robot to calculate the temperature of its environment. Considering robots as analogous to we human being, sensors are devices that make robot feel the world as human do with help of their five senses. We will discuss more on this after few slides, **(press next)** * Moving on to next component, which is actuator. So actuators in robotic system are analogous to human feet and hand which help human being in locomotion and performing all sorts of task. In robot, actuators can be motors, which can be a dc or servo or stepper motor or can be a hydraulic or pneumatic systems which help robot to move, pick objects and perform many other such tasks. **(press next)** * The third major component is the control system of the robot which is the microcontroller or processor of the robot. This is the brain of the robot, which take inputs from sensors or other medium and take decisions on task to be performed. **(press next)** * The decision taken by the robot is the because of the intelligence of the robot. The robot is made intelligent by the codes we write into its memory. So in a way is intelligence of robot is depends upon the intelligence of its master that is we who program it. The better you code, the better your bot will perform. **(press next)** * Moving to next component, which is the power supply. This is the key component without which the robot can never start, just as we human can’t do without food. **(press next)** * The last major building block is the communication system. Just as human being can talk or use sign language for communication, robot also needs communicating devices so that it can send and receive signals from human or other robot.   **(press next)** |
| 04.  Flavors of Firebird-v | * Now we will discuss firebird-v robotics research platform and analysis features of the platform which make it suitable of being called a Robot. So what actually is Firebird-V platform? Firebird-V is a robotics research platform designed and developed at ERTS Lab in Computer Science & Engineering Department of IIT-Bombay with a vision to teach embedded system and robotics with a practical approach. This platform is used at IIT by UG and PG students to do lab work and make their course project. Beside this IIT is using this platform to train students and faculty of various engineering colleges through out the country through project e-Yantra. e-yantra also plan to take this platform outside IIT and give students though out the country, an idea of what robotics is about. This platform is also used to analysis various problem and solve them using the platform at prototype level. **(press next)** * So firebird-V comes in various flavors. For example, first platform has 8051 core based NXP manufactured P89v51rd2 microcontroller. **(press next)** * Second configuration uses AVR architecture based ATmega2560 microcontroller. * And the third configuration uses ARM architecture based LPC2148 microcontroller. So basically all platform uses different controller which gives different processing capabilities and as a user we have freedom to select anyone of them.**(press next)** |
| 05.  Firebird V P89v51RD2 | * Now let us see overview of each platform individually. Let us look at P89v51RD2 based firebird V platfrom **(press next)** * This is how bot looks **(press next)** * So all firebird-V platform has two PCBs. You can see your robot. The bottom PCB is the main board which has various circuits and other components. The Top layer, called as daughter board is the board which has the microcontroller. In this platform we have Philips manufactured and 8051 based microcontroller named as P89v51rd2.   **(press next)** |
| 06.  Firebird V ATmega2560 | * The second platform is ATmega2560 based Firebird-V robot **(press next)** * So as you can see, this looks similar in structure as P89v51rd2 based platform. So as I said all board two PCB, bottom PCB is same and top PCB or the adaptor board uses ATMEL manufactured and AVR architecture based ATmega 2560 microcontroller. So this platform is slightly advanced and provides more features as compared to 8051 based board. **(press next)**   **(press next)** |
| 07.  Firebird V LPC2148 | * The third configuration is LPC 2148 based Firebird –V robot **(press next) (press next)** * So this platform uses ARM-7 architecture based LPC 2148 microcontroller. It is a 32-bit controller and provides even more functionality as compared to previous two boards. So one can switch to this board after learning basics of controller. We are using this platform and will learn more about it as we progress further. **(press next)** |
| 08  LCD Interfacing | * As we have discussed earlier about basic building blocks of any robotics system**(press next)** * We will now consider Firebird platform and see each building blocks in details as present on this platform.   **(press next)** |
| 09  Some Important Command | * So let us look at the sensors present on the firebird V platfrom **(press next)** * First is the Sharp IR range sensor. **(press next)** * This sensor is used for measuring distance of any object from the robot. It has an Infrared emitter which emits infrared light and a CCD array as the receiver. So when any object comes in front of the robot, Infrared light emitted from the senor strikes the object and is reflected back. This reflected ray is received by array of CCD at receiver side, so a triangle is formed with emitter, object and receiver as three vertices and depending upon distance of the object, the angle between incident ray and reflected ray changes. This change of angle gives the distance of any object in front of the robot. So the major advantage of this sensor is that it does not depend on color of object. Even if small light is reflected from the surface, it will be received by receiver and hence angle can be found and distance can be calculated. **(press next)** * This sensor is available in various ranges. The commonly used have range of 4cm to 30cm, 10cm to 80cm and are called as GP2D120 and GP2D12 respectively. Beside there are other range sensors also available, selection depends on application you are using it for * On firebird –V platform, we can attach five such sensors. Positions for placing these sensors are shown in the figure. |
| 10  Steps for LCD initialization | * Next Sensor is known as IR Proximity sensors **(press next)** * This sensor is also used for distance measurement or can also be used for object detection. However the range of this sensor is very small. It can measure distance only upto 10cm. **(press next)** * These sensors also have an IR transmitter which emits infrared light and uses a phototransistor as receiver. These sensors can be used in conjunction with sharp sensors for better resolution.**(press next)** * On firebird –V platform, we can attach eight such sensors. Positions for placing these sensors are shown in the figure. **(press next)** |
| 11  Syntax for C program | * Next we have Whiteline sensors **(press next)** * As name suggest, these sensors can be used for sensing white line. This sensor has Red LED as emitter and phototransistor as receiver. Working of this sensor is very simple physics. That is, Black surface absorbs all light incident on it whereas white surface reflects light incident on it. So Phototransistor receives different amount of reflected light at black and white surface and so robot can make out whether robot is on black surface or white surface. **(press next)** * Array of three white line sensors are provided with the platform, however array of five and seven whiteline are also available and can be interfaced easily. Its location on firebird is shown in the figure.   **(press next)** |
| 12  Syntax for C program | * Moving on to the next sensor, we have Position encoder **(press next)** * These sensors are used for measuring the distance robot has moved or the angle by which robot has rotated. This sensor has IR LED as emitter and phototransistor as receiver. Beside there is a slotted disk assembly which is placed between the transmitter and the receiver. The slotted disk is connected to the shaft of dc motor. Whenever the motor rotate, slotted disk also moves. Now when the slot is there between the receiver and transmitter, IR light will be received by the receiver but when disk comes in between the receiver and transmitter, IR light will not be received by the receiver. So we get a pulse high and low depending on whether disk or slot is between receiver and transmitter. By counting the pulse we can measure how much dc motor has rotated and accordingly what is the distance moved. We will cover programming of this in video tutorial for Interrupt where you can get clearer picture of this. **(press next)** * On firebird-v platform two position encoders are present on both the dc motors.   **(press next)** |
| 13  Steps for LCD initialization | * Next we have Infrared TSOP receiver **(press next)** * This sensor is used when you wish to control the robot using TV remote control. Remotes have an IR LED and this sensor has a phototransistor. So when you press button on remote that can be received by the robot using this TSOP receiver. We are using TSOP 1738 on the platform. **(press next)** * On firebird –V platform, one TSOP sensor is present. Positions for of this sensor is as shown in the figure. **(press next)** |
| 14 | * Next we have Servo Mounted Sensor pod **(press next)** * This is an add-on module and not present on the firebird platform. This pod can be used to mount camera or sensor. It has two servo motors attached so we can have pan and tilt motion. This module can be used for things like room mapping or tracing object and various other applications **(press next)** |
| 15 | * Next we have Accelerometers **(press next)** * This also is an add-on module and not present on the firebird platform. Accelerometers give acceleration of object in 3Dimension. In market accelerometers are available which can give acceleration either on one axis or two axes or three axes. So depending on it accelerometers have upto three output pins which can be interfaced with the platform and accordingly readings can be obtained and computed according to need. **(press next)** |
| 16 | * Next we have Gyroscope **(press next)** * This also is an add-on module and is not present on the firebird platform. Gyroscope provides angular velocity of the object. These sensors can be used for maintain the orientation of the object and hence maintain its stability. **(press next)** |
| 17 | * Next we have Ultrasonic sensors **(press next)** * This also is an add-on module and is not present on the firebird platform. Ultrasonic sensors are used for object detection and distance measurement. One can easily interface this on the robot in the slot provided of this. This sesnors can be used as an alternative to sharp sensors. **(press next)** |
| 18 | * Next we have Motion Sensors **(press next)** * This also is an add-on module and is not present on the firebird platform. Passive infrared Motion sensors are used for detecting live object. These are found in places such as office or washroom where lights and fans are controlled depending on whether someone is present or not. These sensors can also be easily interfaced on the firebird platform. **(press next)** |
| 19 | * Next we have GPS or Global Positioning System **(press next)** * This also is an add-on module and not present on the firebird platform. This module when interfaced on robot can give the location of the robot by receiving signals from the GPS signal. It gives locations in terms of longitude and latitude. **(press next)** |
| 20 | * So we have discussed some of the commonly used sensors. Few of them are interfaced on the robot and ready to use while other can be purchased from the market according to the need of application. Also beside the sensors I have mentioned, you can interface lots of other sensors also with the platform. Now let us move to next major component, which is Actuators **(press next)** * For actuations you can use DC motor and servo motors. Two DC motor is interfaced with the platform. These DC motor are connected with the wheels of thr robot. DC motors are 60rpm motors. You can attach two more dc motors to the platform, driver IC are present on the robot. You can refer to hardware manual of the robot given in the DVD for getting the port and connection details. Talking of servo motors, you can attach upto three servo motors to the robot. These servo motors come handy if you wish to make some kind of arm or gripper structure on the platform. Servo motors are add-on module, you need to purchase it from the market. **(press next)** |
| 21 | * Coming to the control system of the robot **(press next)** * As discussed earlier, microcontroller is the main control unit of the system. So in this case, controller used on firebird platform is PHILIPS manufactured, ARM architecture based LPC2148 microcontroller. **(press next)** |
| 22 | * Next let us see what makes robot intelligent. * So as discussed in first slide, intelligence of robot is the user written code. So we will write code in embedded C language which is similar to the C programming with slight modifications to make language suitable for accessing hardware connected at controller pin. Also the code we write in C language is not understood by the machine so we have to convert the code into a machine language which we will call as hex. We will learn how to compile code, generate .hex file and load it into microcontroller’s memory when we start writing the code. A reference note is given in the documentation DVD with the video tutorial which explains the process. We will see how to write code in another tutorial. |
| 23 | * For Powering the system * We have two different modes for powering the robot. First is battery powered. A nikel metal hydrid battery of 9.6V and 2100mill amp is given with the robot for powering. Second mode of powering is through auxiliary power. A 9Volt,1Ampere DC adaptor is given with the robot for powering the robot. You must read the hardware manual to get used to both these sources. It is also very important that you power the robot only after reading the instructions in manual. Using Power source in wrong way can permanently damage the robot. |
| 24 | Next is the communication standards  So communication can be done in two way, either wirelessly or wired.  So wired Communication is through USB cable or through RS-232. Since RS232 port is not present on the laptops and systems now a day, so a usb to serial converter can be used for the communication. We will use USB communication through a USB cable supplied with the robot as main source for communication between system and robot. It will also be used while you are programming the robot that is loading the .hex file into the flash memory. Wireless communication is done using x-bee module. Xbee is based on IEEE 802.15.4 protocol. Connection channel for xbee module is present on the robot but xbee is a add-on module which you can purchase from market if needed.  Communication thorough Infrared TV remote is already discussed and can be considered as a wireless way of communication between the robot and human. |
| 25 | Indicating Devices are the module which will be helpful to the programmer while debugging. So indicating devices present on the firebird platform are  First is 16 cross 2 alpha numeric LCD which is present on the robot.  Then we have a buzzer  And then a barLED. All these devices are present on the robot and are programmable. |
| 26 | In this slide I have shown the block diagram of firebird-V robot. We have already discussed these in earlier slides so this can be used for reference and a overview.  So here we have shown microcontroller LPC 2148, through the controller we have connected Position encoders , 3 white line sensors, three sharp sensors i.e. 2,3,4, one servo pod sensor s3. One LCD and one switch is also interfaced with LPC 2148 microcontroller. As I have discussed in earlier slides, you can connect upto four DC motors for which two motor drivers are already interfaced on the platform. Buzzer is also connected to the microcontroller. For communication as discussed earlier, xbee is connected, RS232, USB and TSOP is present. Then another important feature in firebird is the slave controller. Slave microcontroller is used in case when all analog channels of master are exhausted and you want to connect more analog sensor, so you can do it by connecting the extra device to slave controller. Slave controller will get signals from master controller and it will perform accordingly. In case of firebird V LPC2148 platform, two ATmega8 are used as slave controllers. In slave controller 1, sharp sensor 1, four proximity sensors numbered 1,8,6 and 7, two servo pod sensors s1 and s2, one white line sensor i.e sensor number 7 is connected. In slave controller 2, sharp sensor 5, three white line sensors 4,5 and 6, four proximity sensors numbered 2,3,4 and 5 are connected. |
| 27.  Thank you | So we have understood the capabilities of the robot and have seen various features of it. However this platform is huge and understanding all of it at once is difficult, so I suggest you to use the hardware manual throughout the use of robot.  With this we have come to end to this tutorial. Thank you for listening. For any queries or doubts you can visit <http://qa.e-yantra.org/>  This is Bhumika Varshney Signing off!! |