

EMBEDDED SYSTEM REPORT ON 5 DAYS INTERNSHIP IN ADVENTURE TECHNOLOGY SOLUTIONS PVT LTD

EMBEDDED SYSTEM

Submitted in partial fulfilment of the requirements for the completion of

PROFESSIONAL TRAINING

By

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**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING**

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with grade “A++” by NAAC

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SATHYABAMA

OCTOBER 2023

**INSTITUTE OF SCIENCE AND TECHNOLOGY
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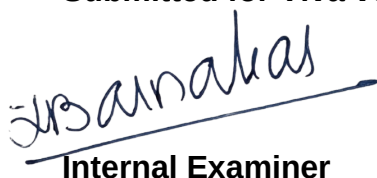
This is to certify that this Professional training report is the Bonafide work of **VARSHA S (41140093)** who carried out the reports entitled **"INTERNSHIP TRAINING IN ADVENTURE TECHNOLOGY SOLUTIONS PVT LTD "** from Date **15.05.2023 TO 19.05.2023**


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DECLARATION

I , **VARSHA S (41140093)**, hereby declare that the " **INTERNSHIP TRAINING**" done by me at "**ADVENTURE TECHNOLOGY SOLUTIONS PVT LTD**" is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering



DATE :

SIGNATURE OF THE CANDIDATE

PLACE :

ACKNOWLEDGEMENT

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CHAPTER 1

INTRODUCTION

“Adventure Technology solutions providing Engineering R&D services, Developing Engineering Projects, Internships, Training & Placement assistance, Technology consulting and product development for engineering students and clients. We are also offering Software Training Embedded systems Training Engineering projects, Software Development and Embedded Products Development at Adventure, innovation is not just another word, it's part of our organizational heritage. We strongly believe that empowering education can change society's ecosystem tremendously. For empowerment of engineering students and graduates we are transferring the knowledge through Training and engineering projects solutions with R&D services”.

1.1 VISION OF THE COMPANY

“To Make Education empowerment and enrich people's lives through knowledge and technology Innovations”

“Every block of stone has a statue inside it and it is the task of sculpture to discover it – Adventure transformation does”

1.2 MISSION OF THE COMPANY

Create Technical Innovations with engineering projects. Make our products sustainably. Adventure builds creative inventions to discover and to make positive impact in education system through training and development.

CHAPTER 2

OBJECTIVES

Internships are generally thought of to be reserved for college students looking to gain experience in a particular field. However, a wide array of people can benefit from Training Internships in order to receive real world experience and develop their skills.

An objective for this position should emphasize the skills you already possess in the area and your interest in learning more.

Internships are utilized in a number of different career fields, including architecture, engineering, healthcare, economics, advertising and many more.

Some internship is used to allow individuals to perform scientific research while others are specifically designed to allow people to gain first-hand experience working.

Utilizing internships is a great way to build your resume and develop skills that can be emphasized in your resume for future jobs. When you are applying for a Training Internship, make sure to highlight any special skills or talents that can make you stand apart from the rest of the applicants so that you have an improved chance of landing the position.

CHAPTER 3

EMBEDDED SYSTEM

An embedded system is a combination of computer hardware and software designed for a specific function. Embedded systems may also function within a larger system. The systems can be programmable or have a fixed functionality. Industrial machines, consumer electronics, agricultural and processing industry devices, automobiles, medical equipment, cameras, digital watches, household appliances, airplanes, vending machines and toys, as well as mobile devices, are possible locations for an embedded system.

While embedded systems are computing systems, they can range from having no user interface (UI) -- for example, on devices designed to perform a single task -- to complex graphical user interfaces (GUIs), such as in mobile devices. User interfaces can include buttons, LEDs (light-emitting diodes) and touchscreen sensing. Some systems use remote user interfaces as well.

3.1 SYSTEM DESIGN

A system is an arrangement in which all its unit assemble work together according to a set of rules. It can also be defined as a way of working, organizing or doing one or many tasks according to a fixed plan. For example, a watch is a time displaying system. Its components follow a set of rules to show time. If one of its parts fails, the watch will stop working. So we can say, in a system, all its subcomponents depend on each other.

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.

3.2 CHARACTERISTICS

- Single-functioned – An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.
- Tightly constrained – All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.
- Reactive and Real time – Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or de-accelerations repeatedly within a limited time; a delayed computation can result in failure to control of the car.
- Microprocessors based – It must be microprocessor or microcontroller based.

CHAPTER 4

BASIC STRUCTURE OF AN EMBEDDED SYSTEM

4.1 SENSOR

It measures the physical quantity and converts it to an electrical signal which can be read by an observer or by any electronic instrument like an A2D converter. A sensor stores the measured quantity to the memory.

The choice of sensor depends on the specific requirements of the application, including accuracy, range, speed, and environmental conditions. Integration of the right sensors is essential for the embedded system to perform its intended function effectively.

4.2 A-D CONVERTER

An analog-to-digital converter converts the analog signal sent by the sensor into a digital signal .

The choice of ADC in an embedded system depends on factors such as required resolution, speed, power consumption, and cost constraints. It's essential to select the right ADC to ensure accurate and reliable conversion of analog signals into digital data for processing and decision-making within the embedded system.

4.3 PROCESSOR AND ASICs

Processors process the data to measure the output and store it to the memory. In many embedded systems, a combination of processors and ASICs is used to strike a balance between general computing capabilities and specialized, optimized hardware for critical tasks. The choice between processors and ASICs depends on the specific requirements and constraints of the embedded system's application.

4.4 D-A CONVERTER

A digital-to-analog converter converts the digital data fed by the processor to analog data.

The choice of a DAC type and its resolution depends on the specific requirements of the embedded system, including the required accuracy, speed, and cost constraints. Integrating a DAC allows embedded systems to bridge the gap between digital processing and the analog world, enabling a wide range of applications.

4.5 ACTUATOR

An actuator compares the output given by the D-A Converter to the actual (expected) output stored in it and stores the approved output.

The choice of actuator depends on the specific requirements of the embedded system, including the type of motion needed, precision, speed, and power constraints. Actuators are essential components that enable embedded systems to interact with and manipulate the physical world, making them integral to applications like robotics, automation, automotive systems, and more.

CHAPTER 5

NATURE OF WORKDONE

5.1 INTRODUCTION ABOUT EMBEDDED SYSTEM

An Embedded System is a system that has software embedded into computer-hardware, which makes a system dedicated for a variety of application or specific part of an application or product or part of a larger system.

An embedded system can be a small independent system or a large combinational system. It is a microcontroller-based control system used to perform a specific task of operation.

An embedded system is a combination of three major components:

- **Hardware:** Hardware is physically used component that is physically connected with an embedded etc. system. It comprises of microcontroller based integrated circuit, power supply, LCD display.
- **Application software:** Application software allows the user to perform varieties of application to be run on an embedded system by changing the code installed in an embedded system.
- **Real Time Operating system (RTOS):** RTOS supervises the way an embedded system work. It act as an interface between hardware and application software which supervises the application software and provide mechanism to let the processor run on the basis of scheduling for controlling the effect of latencies.

5.2 C LANGUAGE AND EMBEDDED C

C LANGUAGE

C is a general-purpose programming language, which is widely used to design any type of desktop-based applications. It was developed by Dennis Ritchie as a system

programming language to develop the operating system. The main features of C language include low-level access to memory, a simple set of keywords, and clean style, these features make C language suitable for system programmings like OS or compiler development. In nature it uses a native platform development scheme, ie the development of the application by it is platform-dependent and can only be used on a single platform.

EMBEDDED C

Embedded C is an extension of C language and it is used to develop micro-controller based applications. The extensions in the Embedded C language from normal C Programming Language is the I/O Hardware Addressing, fixed-point arithmetic operations, accessing address spaces, etc. Embedded C Program has five layers of Basic Structures. They are:

Comment: These are simple readable text, written in code to make it more understandable to the user. Usually comments are written in `//` or `/* */`.

Pre-processor directives: The Pre-Processor directives tell the compiler which files to look in to find the symbols that are not present in the program.

Global Declaration: The part of the code where global variables are defined.

Local Declaration: The part of the code where local variables are defined.

Main function: Every C program has a main function which drives the whole code. It basically has two parts the declaration part and the execution part. Where, the declaration part is where all the variables are declared, and the execution part defines the whole structure of execution in the program.

In nature it uses a cross-platform development scheme, i.e., the development of the application by it is platform-independent and can be used on multiple platforms.

Software Testing:

Software testing is the process of verification and validation for a software. It ensures that a software or application is free from defects and viruses. It also ensures that software fulfills the requirements of end user as designed and developed. It makes

sure that software meets the user requirements effectively and efficiently and also handles all the exceptional and boundary cases.

Embedded Testing:

Embedded testing is the process of verification and validation of both software and hardware. It ensures the defect free whole system including software and hardware. It is basically performed on hardware in order to find the defects. It also ensures that system meets the end user's requirements.

5.3 CLASSIFICATION OF EMBEDDED SYSTEMS

Embedded Systems are classified based on the two factors i.e.

- Performance and Functional Requirements
- Performance of Micro-controllers

Based on Performance and Functional Requirements it is divided into 4 types as follows :

Real-Time Embedded Systems :

A Real-Time Embedded System is strictly time specific which means these embedded systems provides output in a particular/defined time interval. These type of embedded systems provide quick response in critical situations which gives most priority to time based task performance and generation of output. That's why real time embedded systems are used in defense sector, medical and health care sector, and some other industrial applications where output in the right time is given more importance.

Further this Real-Time Embedded System is divided into two types .They are,

Soft Real Time Embedded Systems

In these types of embedded systems time/deadline is not so strictly followed. If deadline of the task is passed (means the system didn't give result in the defined time) still result or output is accepted.

Hard Real-Time Embedded Systems

In these types of embedded systems time/deadline of task is strictly followed. Task must be completed in between time frame (defined time interval) otherwise result/output may not be accepted.

Examples:

- Traffic control system
- Military usage in defense sector
- Medical usage in health sector

Based on performance and micro-controller it is divided into 3 types follows:

Small Scale Embedded Systems :

Small Scale Embedded Systems are designed using an 8-bit or 16-bit micro-controller. They can be powered by a battery. The processor uses very less/limited resources of memory and processing speed.

Medium Scale Embedded Systems :

Medium Scale Embedded Systems are designed using an 16-bit or 32-bit micro-controller. These medium Scale Embedded Systems are faster than that of small Scale Embedded Systems. Integration of hardware and software is complex in these systems. Java, C, C++ are the programming languages are used to develop medium scale embedded systems.

Sophisticated or Complex Embedded Systems :

Sophisticated or Complex Embedded Systems are designed using multiple 32-bit or 64-bit micro-controller. These systems are developed to perform large scale complex functions.

5.4 EXAMPLES OF EMBEDDED SYSTEM

Some examples of embedded systems:

- Digital watches
- Washing Machine
- Toys
- Televisions
- Digital phones
- Laser Printer
- Cameras
- Industrial machines
- Electronic Calculators
- Automobiles
- Medical Equipment

5.5 APPLICATION

Mostly Embedded systems are present everywhere. We use it in our everyday life unknowingly as in most cases it is integrated into the larger systems. So, here are some of the application areas of Embedded systems:

- Home appliances
- Transportation
- Health care
- Business sector & offices
- Defense sector
- Aerospace
- Agricultural Sector

5.6 ADVANTAGES AND DISADVANTAGES

Advantages of Embedded System:

- Embedded systems are fast in performance.
- These systems consumes less power
- Small in shape and size.
- These systems are so scalable and reliable.
- Works on wide variety of sectors and environments.
- Improve product quality and enhance performance.
- Performs specific tasks without error.

Disadvantages of Embedded System:

- Difficult to backup of embedded files.
- Sometimes complex to develop.
- Integration may be a problem.
- Offer very limited resources for processing.
- Troubleshooting may be difficult.
- Maintenance may be a problem.

CHAPTER 6

METHODS AND PROCESS

6.1 HARDWARE DESIGN

Understanding and designing the hardware components of embedded systems, such as microcontrollers, sensors, actuators, and communication interfaces.

Embedded systems design is the process where hardware and firmware designers come together to build embedded systems from scratch. This involves PCB design, where the necessary components are connected to build functional circuits.

6.2 PROGRAMMING

Learning how to program these embedded systems using languages like C, C++, or assembly language to control their behavior.

Embedded systems can be programmed using different programming languages like Embedded C, Embedded C++, Embedded Java, and Embedded Python.

6.3 REAL TIME SYSTEM

A real-time embedded system is a particular version of an embedded system that works on the basis of real-time computing represented by a dedicated type of operating system — RTOS. Its working principles are as follows: Quick response to external factors: an embedded system must work within fixed time constraints.

6.4 SENSORS AND ACTUATORS

Working with various sensors to collect data and actuators to control physical processes.

Actuators and sensors are two vital components of embedded and electronic systems. Actuators form a link with the output ports while sensors connect to the input ports of a given system.

CHAPTER 7

KNOWLEDGE AND EXPERIENCE

7.1 KNOWLEDGE GAINED

During an embedded system internship, you will acquire a comprehensive range of knowledge and skills crucial to the field. You will delve into the intricacies of embedded programming, mastering languages like C and assembly while gaining expertise in low-level coding. Understanding microcontroller architecture and its various components, such as memory management, I/O ports, timers, and interrupt handling, will become second nature. You'll learn to navigate real-time systems, ensuring tasks and events adhere to strict timing requirements. The internship will equip you with the ability to seamlessly integrate software with hardware components, including the development and optimization of device drivers. You'll become proficient in utilizing essential embedded development tools, like integrated development environments (IDEs), compilers, and debugging utilities. Additionally, interfacing with sensors, actuators, and external devices via protocols such as SPI, I2C, and UART will become routine. Your grasp of real-time operating systems (RTOS) will enable you to develop software for multitasking and resource management. You'll also gain skills in debugging techniques and testing methods specific to embedded systems, using tools like oscilloscopes and logic analyzers. Understanding power-saving techniques and designing efficient power supply circuits will be a fundamental part of your knowledge base. You will familiarize yourself with industry-specific standards and regulations, particularly in fields like automotive, medical devices, and aviation. Your troubleshooting abilities will develop, allowing you to diagnose and resolve hardware and software issues in embedded systems. Working within multidisciplinary teams and collaborating with hardware engineers, software developers, and domain experts will be a central aspect of your internship. Hands-on experience in building prototypes of embedded systems, testing them, and iterating on the design will provide invaluable practical insight. Depending on the industry or application, you may also gain domain-specific knowledge, such as automotive electronics, IoT devices, medical devices, or industrial automation. Finally, you'll learn to document your work effectively, creating

detailed technical documentation and reports, rounding out your skillset for a successful career in embedded systems development or related fields.

7.2 EXPERIENCE

An embedded system internship offers a transformative experience that equips you with a profound understanding of embedded systems development. Throughout this internship, you will gain hands-on experience, working on real-world projects that demand creativity and innovation. You will become intimately familiar with the entire development lifecycle, from conceptualization and design to implementation and testing. You'll learn to tackle the unique challenges of embedded programming, mastering languages like C and assembly while optimizing code for performance and resource efficiency. Your understanding of microcontroller architecture and real-time systems will enable you to craft solutions that meet stringent timing requirements. You'll develop a keen eye for hardware-software integration, seamlessly connecting software to diverse hardware components and crafting efficient device drivers. The internship will nurture your proficiency in utilizing development tools, debugging techniques, and testing methodologies specific to embedded systems. You'll gain expertise in power management, PCB design, and compliance with industry standards, ensuring your embedded solutions are robust and reliable. Working collaboratively with multidisciplinary teams, you'll experience the synergy between hardware and software engineers, witnessing how their efforts converge to create functional systems. Prototyping and testing will become second nature, as you build, debug, and iterate on your embedded projects. Depending on the industry focus, you may also acquire domain-specific knowledge, further enriching your skill set. This comprehensive experience prepares you for a dynamic career in embedded systems, where you can make a meaningful impact by designing the technology that powers countless devices and systems in our modern world.

CHAPTER 8

FUTURE SCOPE

8.1 ARTIFICIAL INTELLIGENCE AND MACHINE LANGUAGE

Embedded AI and ML will enable devices to make real-time decisions, enhancing automation and intelligence in various applications.

8.2 INTERNET OF THINGS

Embedded systems are at the core of IoT devices, which are becoming increasingly prevalent in homes, industries, and smart cities.

8.3 SECURITY CONCERN

Embedded systems security will be a growing concern as more devices become connected. This will lead to increased demand for secure embedded solutions.

8.4 CUSTOMIZATION AND FPGA INTEGRATION

Tailored embedded systems for specific applications will continue to be in demand, enabling innovation in niche markets.

8.5 ENERGY EFFICIENCY

As energy conservation becomes more critical, embedded systems will play a role in optimizing power consumption in various devices.

8.6 HEALTHCARE DEVICES

Medical devices and wearables rely on embedded systems for monitoring, diagnostics, and treatment.

8.7 AUTONOMOUS SYSTEMS

Embedded systems are crucial for advanced driver-assistance systems (ADAS), autonomous vehicles, and electric vehicles.

CHAPTER 9

CONCLUSION

As an undergraduate of Sathyabama institute of science and technology I would like to say that this **INTERNSHIP TRAINING** is an excellent opportunity for me to get the ground level experience the things. I would have never gained through going straight into a job. I'm grateful to **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** and **ADVENTURE TECHNOLOGY SOLUTIONS PVT LTD** for giving me this wonderful opportunity. Thus, I believe that my training session will be beneficial and hence our efforts will be fruitful.