Embedded Systems and Applications in Robotic

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***Abstract:-*A system which is programmed to control and operate a specific function within a mechanical or electrical system in real-time, such a system is anknown as embedded system. This thesis discusses the *embedded* as part of a device which includes electrical, mechanical parts of a robotic application.This system has the ability to control real time devices that are in use today, in industries for domestic as well as commercial purpose. Most of the microprocessors are resulting components of embedded systems.A device developed from embedded systems technology have low power consumption, smaller size and high operating ranges. These characteristics are the reasons why embedded systems is finding its way in every industry based on electronics and thus, creating endless application for its usage as a significant technology.**

Keywords:- Embedded, Robotic Application and Microprocessor.

1. INTRODUCTION

For high precision jobs and under dangerous working conditions for humans the world is now taking advantage of robotic application and technology. A robotic application has primarily three main components:

- Mechanical device, to interact with surroundings.
- Sensors
- Embedded System, to bridge the communication between the mechanical devices and sensors.

With the wide of use of robotics application and advancement of technology around the globe, it is important for humans to acknowledge the Asimov's Three Laws of Robotics which are as follows:

- Robots are the result of human intelligence; thus, they must not harm humans.
- They should be programmed to follow commands and must be precise in their completion of task.
- Robots must have the intelligence to protect themselves in situations of emergency.

Thus, we can understand that a mechanical device which has the ability to react to a situation logically by using the intelligence programmed in it by humans can be classified as a robot.

2. EMBEDDED SYSTEM

An intelligent system that has the ability to solve a specific problem, being an integral part of some large system with hardware and mechanical parts which can perform a specific task.As embedded system can perform specific task, engineers who program has optimized it by reducing the size and cost as well as has increased the reliability and performance.Some most common applications of devices that are created using embedded systems are video games, washing machines and microwaves.An embedded device has the ability to measure,control, display or calculate information.

3. Programmable Devices:

The two of the most significant programmable devices in embedded systems are microprocessor and microcontrollers.These two are basically multipurpose programmable devices that can accept digital input, process it according to the commands or program and generates output accordingly.Today's embedded systems are generally based on microcontrollers but in the case of complex systems microprocessor also find its application.This is because microprocessor chip does not contain memory, peripheralinterface circuits and other such components which are to be connected externally whereas microcontroller contains CPU, memory (RAM/ROM), input/output ports and timers resent on a single chip. Also, microcontroller is small in size, has low cost and low power consumption as compared to microprocessor.

4. Programming Module:

Programming for embeddded system is done on a microcontroller, that is, an already coded program is transferred into the flash memory of microcontroller in order to function as per given commands.There are various software on which the coding part or programming can be done but most commercial and industrial viable software is AVRstudio versions.Codes are written in C language and this software allows us to burn the code directly into the microcontroller memory in the form of HEX file once compiled.

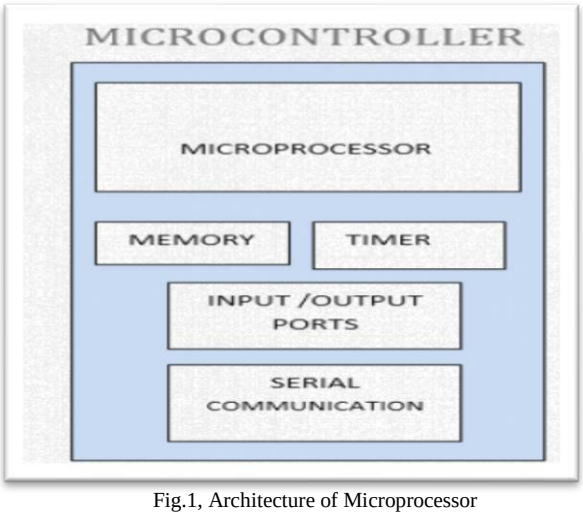

Fig.1, Architecture of Microprocessor

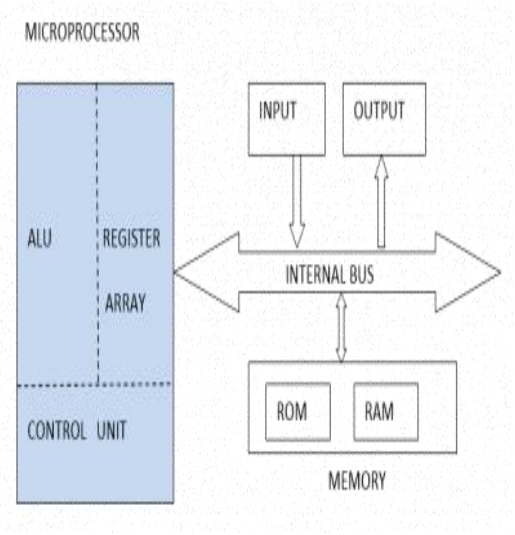

Fig.2, Block structure of Microcontroller

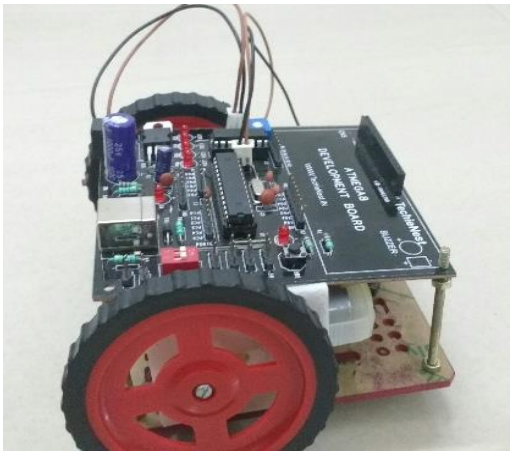

Fig.3, a LFR bot

Code snippet:

```
#define F_CPU 8000000
#include <avr/io.h>
#include <util/delay.h>
int main(void)
{DDRA=0b11111100;
DDRC=DDRB=0b11111111;int count=0;
while(1){
while(count<3)
{
if (PINA==0b00000011)
{PORTB=0b00001001;
}
if(PINA==0b00000010){PORTB=0b00001000; }
if(PINA==0b00000001){PORTB=0b00000001;}
if(PINA==0b00000000){
while(PINA==0b00000000){PORTB=0b00001001;}
count=count++;
PORTC=count;
if(PORTC>=3)break;}
{
PORTB=0b00000000;
}
}
}
}
```

The code is burned into the memory using a device called programmer, the programmer tranfer the hex file of code into the memory.To understand the working of a robot that is programmed using embedded system consider a the most general robotic device that is a “Line Follower Robot”.

The microcontroller is set up on a mechanical device with wheels and sensors. Sensors act as an input unit to detect the white and black path, and depending on the color sensed, a high or a low logic will be sent to microcontroller and accordingly commands will be followed by the two dc motors attached to the control unit that is, the microcontroller.

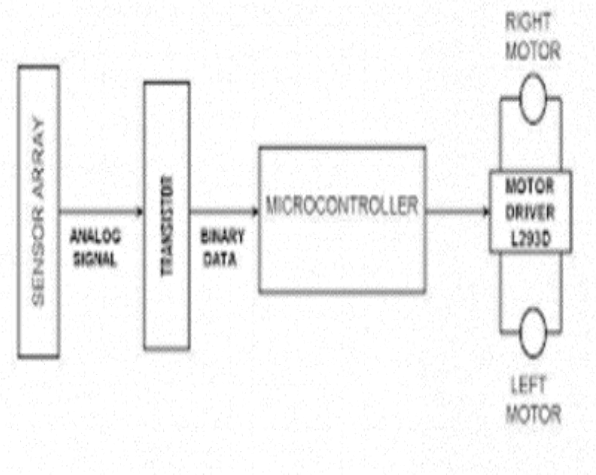

Fig.4, Working of basic LFR bot.

5. APPLICATION IN THE FIELD OF ROBOTICS

With the advancement of technology around the globe, and the dependence of us humans on autocontrolled devices has led to a boom in robotics industry. Robots are considered as the future of humans in those field where risk factor to life is really high.

Manufacturing of robots and advancement in its technology to learn and perform functions on its own that is giving a mechanical device its own brain known as artificial intelligence is possible because of embedded systems whichconstitutes a robot’s internal ciruitary and its ability to performs task.Everyday robots are being challenged to perform new and complex tasks and even those tasks which humans finds difficult to complete.Robotics has changed the coarse of the world, it has opened several new aspects of employment in various field of technology which require basic skill of embeddded system.The future of embedded systems lies inthe advancement of technologies that enable faster communications, heavy data storage capacities and highly interconnections among the devices.These technologies are:

Ubiquitous computing:

Fig.5, ubiquitous computing

It is a branch of computing that focuses on interconnected and communicating devices carefully integrated into the objects we interact with in our daily lives. Today smartphones and tablets are prime targets for ubiquitous computing, and as per trend in advancement this interactive technology will definitey find its way in gaming consoles.

Smart healthcare systems

Having smart healthcare systems is one of the most important applicationembedded systems. It has the ability torevolutionise the way medication is done in this era - Doctors will be able to provide remote medication to people living in rural areas which is estimated to reduce more than 15 per cent of medical expenditure in the country anda big number of lives that would be saved.Telemedicine too as an application of embedded system has gained a lot of importance and is being implemented in countries like France, Spain. But, still Telemedicine is done in a 'store and forward' process where the reports of the patient are sent to doctors,for an expert observation, who are far away andmedication is given based on theiradvise.

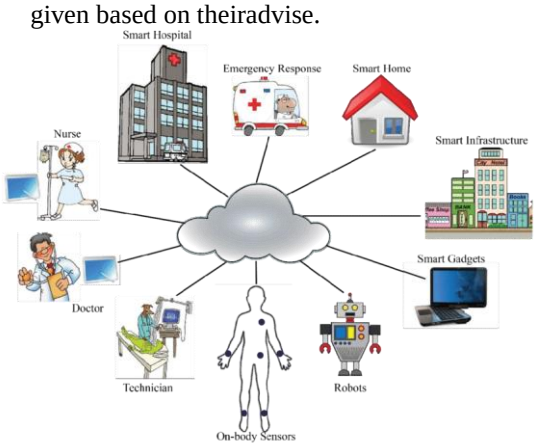

Fig.6, smart healthcare

Artificial human organs can also be created using embedded systems.Apart from the fact that malfunctioned body parts can be replaced, these artificial organs can be used to test drugs and medicine, which is presently done on animal organs.

Intelligent transport systems

Organisations such as Google, Audi and Toyota are already into R&D of intelligent transport systems that will increase the safety and comfort of drivers and are planning to launch them for commercial purposes in near future.

Autonomous vehicle

The autonomous vehicles areequipped with Anti-Lock Braking System which will be triggered when the vehicle is in a potentially dangerous situation. Inter- Vehicular Networks has been established which maintains communication between the vehicles. This will definitely reduce the risk of potential accidents, as generally accidents happen due to humans not being aware on roads and traffic. So, the objective is to ultimately make a Context aware Information System (CAIS) which maintains information about the context of roads and paths. These systems are aimed to have an increased reliability and lower reaction time when compared to humans.

Security and defense

One of the major application and research area for embedded systems has been security and defense, and even in future some of the most promising developments will be seen in this area. High-end reliable devices are developed for military and defense department by complex embedded systems. Consider the case of Gladiator, a US Marine robotic system that can perform functions ranging from surveillance to assault and minimises the risk of marines in threat situations. Drone are replaced by small sized bots that can easily navigate. Also, UK Ministry's Black Hornet, world's first "nano-sized" surveillance system which is a toy sized helicopter which can fly unmanned over an area for about 30 minutes on battery charge. A tentacle system is being developed by US army that has the ability to operate like a human hand and can be used for life-threatening tasks such as Bomb Disposal.

Internet of Things

The Internet of Things is the latest technology revolution that began few years ago. Internet of Thingsallows the connection of the internet to physical devices such as home appliances, manufacturing machines and electronic devices. With the help of cloud computing and increasing access to fastspeed internet everywhere around the world, it will soon be more than just a concept.

Today smartphone has the ability to communicate with our chair about our sitting posture, with satellite receivers to know the right temperature and our cooking gas to know whether the dish you left to simmer on it is burning; in case of a fire hazard, it will communicate with the respective fire control agency in our zone. Industries are aware of the importance of IoT and there are consultancy firms already that specialise in helping you apply IoT at your organization.

6. CONCLUSION

As per today's rapid growth rate, Embedded systems are going to be everywhere – On every floor, every wall, your coffee mug, public transports, cars, homes, offices,

aeroplanes. Observing today's technological industrial trend and possible applications, it is safe to conclude that Embedded Systems will be the most sought after field of study and employment.

As an Embedded systems Engineer, in the near future one would be dealing with some of the most advanced and complicated technologies that will have the ability to revolutionize the world.

7. REFERENCES

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