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A Brief Survey on Robotics

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Abstract— Robotics is the interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, [1] as well as computer systems for their control, sensory feedback, and information processing. These technologies are used to develop machines that can substitute for humans. Robots can be used in any situation and for any purpose, but today many are used in dangerous environments (including bomb detection and de-activation), manufacturing processes, or where humans cannot survive. Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviours usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, and basically anything a human can do. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

Keywords— Robotics, Reprogrammable, Manipulator, Artificial Intelligence, Mechanical.

I. INTRODUCTION

A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks. Computer science, mechanical engineering, electrical engineering and other technologies are used to develop Robots that can substitute for humans. Robots are widely used in manufacturing, assembly, packing and packaging, mining, transport, earth and space exploration, surgery, weaponry, laboratory research, safety, and the mass production of consumer and industrial goods [6]. Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviours usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, and basically anything a human can do. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

II. LITERATURE REVIEW

Concepts related to a robot can be found as long ago as the 4th century BC, when the Greek mathematician Archytas of Tarentum postulated a mechanical bird he called "The Pigeon", which was propelled by steam. Yet another early automaton was the clepsydra, made in 250 BC by Ctesibius of Alexandria, a physicist and inventor from Ptolemaic

Egypt.[8] Hero of Alexandria (10–70 AD) made numerous innovations in the field of automata, including one that allegedly could speak.

One of the first recorded designs of a humanoid robot was made by Leonardo da Vinci (1452–1519) in around 1495. Leonardo's notebooks, rediscovered in the 1950s, contain detailed drawings of a mechanical knight in armour which was able to sit up, wave its arms and move its head and jaw. [16] The design is likely to be based on his anatomical research recorded in the Vitruvian Man but it is not known whether he attempted to build the robot.

A. Etymology

The word robotics was derived from the word robot, which was introduced to the public by Czech writer Karel Capek in his play R.U.R. (Rossum's Universal Robots), which was published in 1920.[3] The word robot comes from the Slavic word robota, which means labour. The play begins in a factory that makes artificial people called robots, creatures who can be mistaken for humans-very similar to the modern ideas of androids. Karel Capek himself did not coin the word. He wrote a short letter in reference to an etymology in the Oxford English Dictionary in which he named his brother Josef Capek as its actual originator. [3]

B. Laws of Robotics

Asimov proposed three "Laws of Robotics" and later added the "zeroth law".

- Law 1: A robot may not injure a human being or through inaction, allow a human being to come to harm, unless this would violate a higher order law.
- Law 2: A robot must obey orders given to it by human beings, except where such orders would conflict with the First law.
- Law 3: A robot must protect its own existence as long as such protection does not conflict with the First or Second law.
- Asimov later added the "Zeroth Law," above all the others: A robot may not harm humanity, or, by inaction, allow humanity to come to harm.

C. History of Robotics

Fully autonomous robots only appeared in the second half of the 20th century. Some of them are as follows;

1) Unimate: The first digitally operated and programmable robot, the Unimate, was designed by George Devol, who coined the term Universal Automation. He later shortened this to Unimation, which became the name of the first robot company. Unimate was installed in 1961 to lift hot pieces of metal from a die casting machine and stack them.

2) Puma: The PUMA (Programmable Universal Machine for Assembly, or Programmable Universal Manipulation Arm) is an industrial robotic arm developed by Victor Scheinman at pioneering robot company Unimation. Initially developed for General Motors, the PUMA was based on earlier designs Scheinman invented while at Stanford University.

3) *Freddy I*: Freddy I (1969–1971) was an experimental prototype, with 3 degrees-of-freedom created by a rotating platform driven by a pair of independent wheels. The other main components were a video camera and bump sensors connected to a computer. The computer moved the platform so that the camera could see and then recognise the objects.[4][5]

4) *Freddy II*: Freddy II (1973–1976) was a 5 degrees of freedom manipulator with a large vertical 'hand' that could move up and down, rotate about the vertical axis and rotate objects held in its gripper around one horizontal axis. Two remaining translational degrees of freedom were generated by a work surface that moved beneath the gripper. The gripper was a two finger pinch gripper. A video camera was added as well as a later a light stripe generator.

III. KEY COMPONENTS OF ROBOTICS

There are some key components of robotics which are very essential. These key components are shown in following figure, Fig.1.

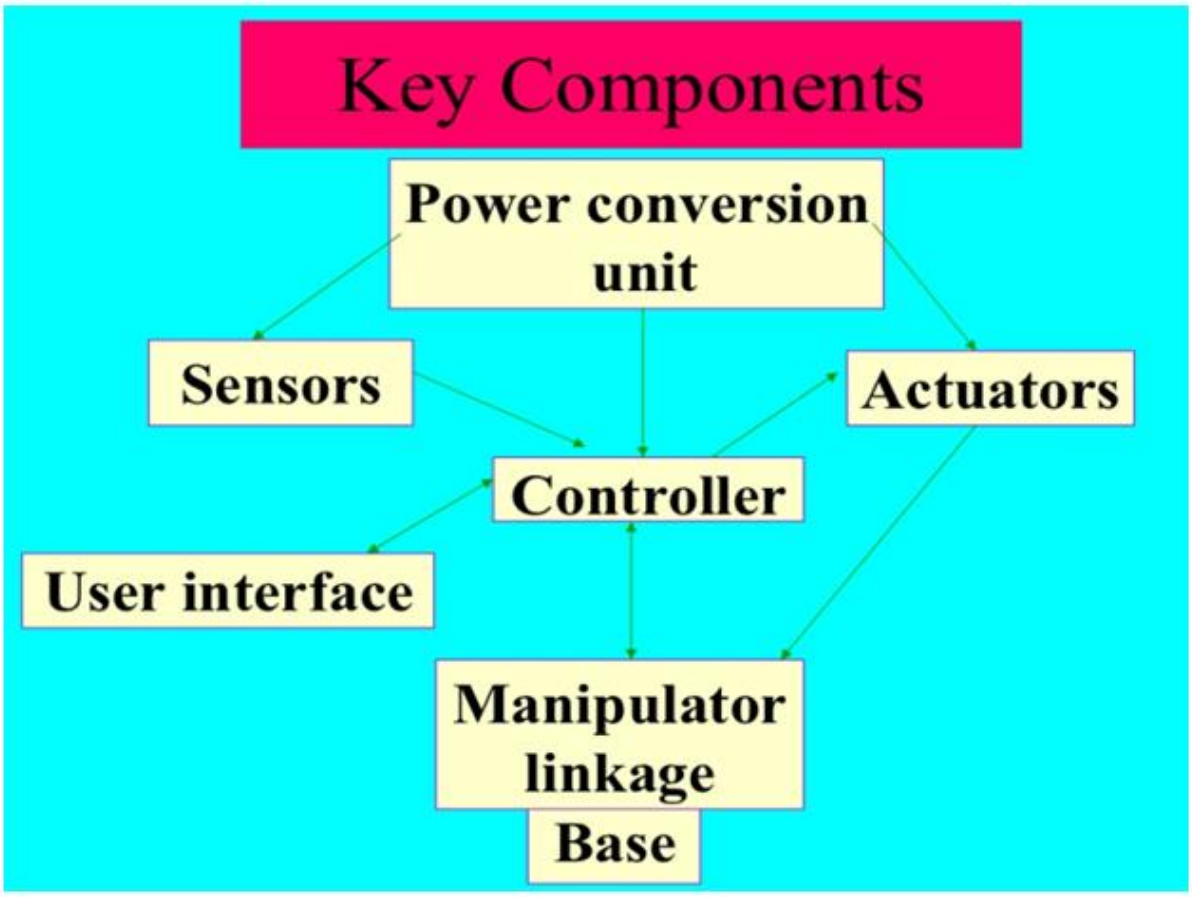

Fig. 1 Key Components of Robotics

Descriptions of the key components are as follows;

- Power Supply - The working power to the robot is provided by batteries, hydraulic, solar power, or pneumatic power sources.
- Actuators - Actuators are the energy conversion device used inside a robot. The major function of actuators is to convert energy into movement.
- Electric motors (DC/AC) - Motors are electromechanical component used for converting electrical energy into its equivalent mechanical energy. In robots motors are used for providing rotational movement.
- Sensors - Sensors provide real time information on the task environment. Robots are equipped with tactile sensor it imitates the mechanical properties of touch receptors of human fingerprints and a vision sensor is used for computing the depth in the environment.
- Controller - Controller is a part of robot that coordinates all motion of the mechanical system. It also receives an input from immediate environment through various sensors. The heart of robot's controller is a microprocessor linked with the input/output and monitoring device. The command issued by the controller activates the motion control mechanism, consisting of various controller, actuators and amplifier.

IV. ROBOTIC ASPECTS

There are many types of robots; they are used in many different environments and for many different uses, although being very diverse in application and form they all share three basic aspects when it comes to their construction. The three aspects are as follows:

A. Mechanical Aspect

Robots all have some kind of mechanical construction, a frame, form or shape designed to achieve a particular task. For example, a robot designed to travel across heavy dirt or mud, might use caterpillar tracks. The mechanical aspect is mostly the creator's solution to completing the assigned task and dealing with the physics of the environment around it. Form follows function. Following figure Fig.2 shows mechanical aspect of robot construction.

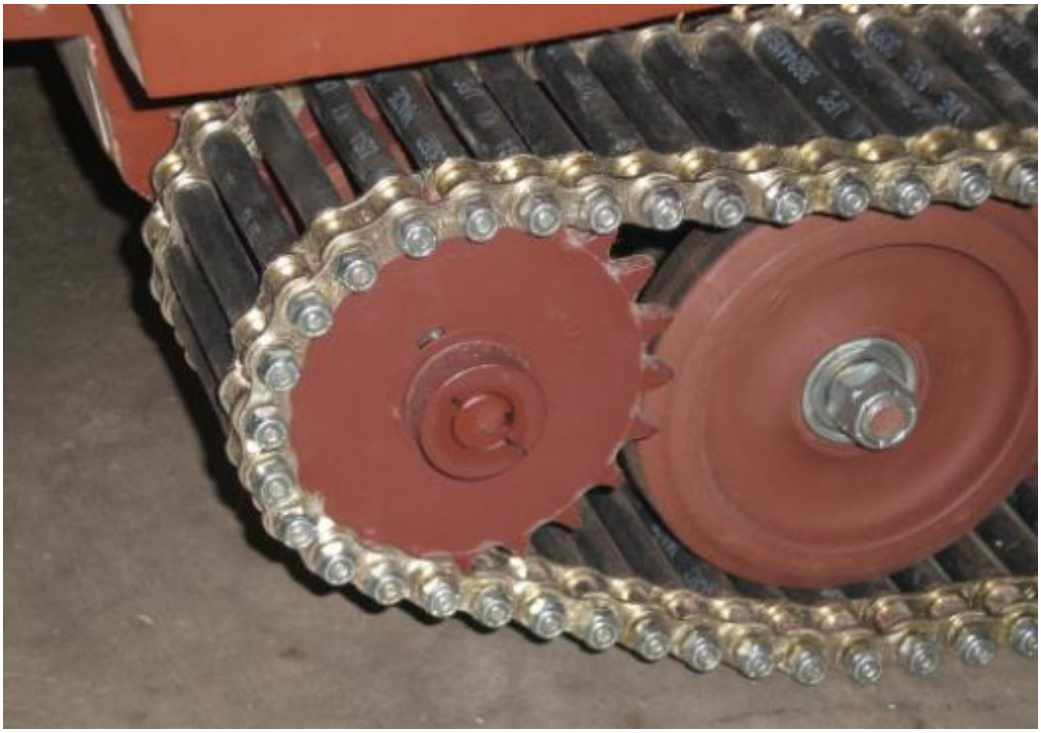

Fig. 2 Robotics Construction showing Mechanical Aspects

B. Electrical Aspect

Robots have electrical components which power and control the machinery. Even petrol powered machines that get their power mainly from petrol still require an electric current to start the combustion process which is why most petrol powered machines like cars, have batteries. The electrical aspect of robots is used for movement (through motors), sensing (where electrical signals are used to measure things like heat, sound, position, and energy status) and operation (robots need some level of electrical energy supplied to their motors and sensors in order to activate and perform basic operations). Following figure Fig.3 shows electrical aspect used in robotics.

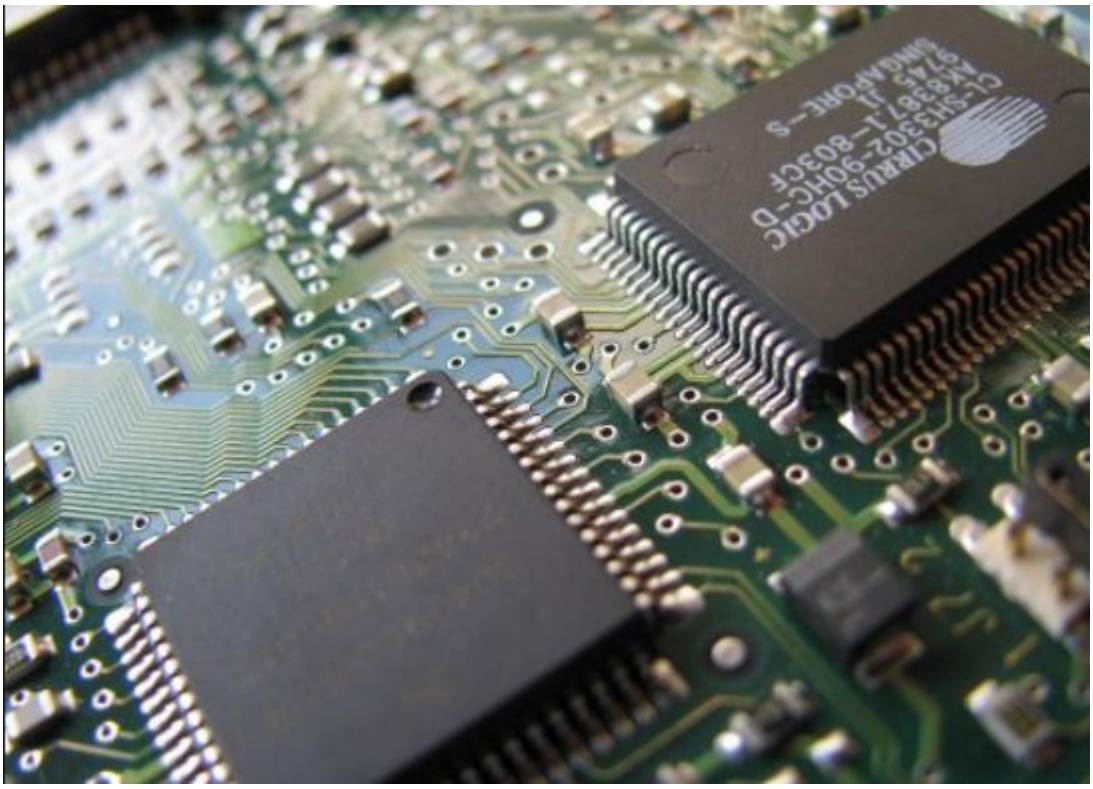

Fig. 3 Electrical Aspects used in Robotics

C. Computer Programming Aspects

All robots contain some level of computer programming code. A program is how a robot decides when or how to do something. In the caterpillar track example, a robot that needs to move across a muddy road may have the correct mechanical construction and receive the correct amount of power from its battery, but would not go anywhere without a program telling it to move. Programs are the core essence of a robot, it could have excellent mechanical and electrical construction, but if its program is poorly constructed its performance will be poorer. There are three different types of robotic programs: remote control, artificial intelligence and hybrid. A robot with remote control programming has a pre-existing set of commands that it will only perform if and when it receives a signal from a control source, typically a human being with a remote control. It is perhaps more appropriate to view devices controlled primarily by human commands as falling in the discipline of automation rather than robotics. Robots that use artificial intelligence interact with their environment on their own without a control source, and can determine reactions to objects and problems they encounter using their pre-existing programming. Hybrid is a form of programming that incorporates both AI and RC functions. Following figure Fig.4 shows a level of computer programming used in robot construction.


```
// Dev-C++ 4.9.9.2
// Project Type: Win32 GUI
// Window: Window Header
#include <Windows.h>
#include "resource.h"
// Window: Window Name
#ifdef NULL
#undef NULL
#define NULL 0
#endif
#define Wnd_Class "WIN_CHK"
#define Wnd_Title "預設視窗"
// Window: Window Parameters
static UINT WndPos_X = 0, WndPos_Y = 0;
// 400 x 300
static UINT WndPos_Width = 400, WndPos_Height = 300;
static HWND hwndWnd = 0;
static HINSTANCE hinstWnd = 0;
LRESULT CALLBACK WndProc(HWND, UINT, WPARAM, LPARAM);
BOOL ProcMsg(void);
BOOL BuildWnd( const char*, const char*);
void InitWindow_PositionCenter( UINT&, UINT&, UINT, UINT, BOOL);
// Window: Window Entry
int WINAPI WinMain(HINSTANCE hInstance, HINSTANCE hPrevInstance,
                   LPSTR lpCmdLine, int nShowCmd)
{
    //==START of WinMain==//
    if ( (hwndWnd = ::FindWindow( Wnd_Class, Wnd_Title)) != NULL )
    {
        ::SetForegroundWindow(hwndWnd);
        return NULL;
    }
    if ( BuildWnd( Wnd_Class, Wnd_Title) == TRUE )
    {
        while ( ProcMsg() == TRUE );
    }
    //==END of WinMain==//
    return NULL;
}
```

Fig. 4 A level of Computer Programming

V. APPLICATIONS

Currently, robots perform a number of different jobs in numerous fields and the amount of tasks delegated to robots is rising progressively.

A. Industrial Robots

An industrial robot is a manipulator designed to move materials, parts and tools, and perform a variety of programmed tasks in manufacturing and production settings. Industrial robots are reshaping the manufacturing industry. They are often used to perform duties that are dangerous or unsuitable for human workers.

B. Domestic or Household Robots

These robots are being used at home. This sort of robot consists of numerous different gears, for example- robotic pool cleaners, robotic sweepers, robotic vacuum cleaners, robotic sewer cleaners and other robots that can perform different household tasks. Also, a number of scrutiny and tele-presence robots can also be considered as domestic robots if brought into play in that sort of environment.

C. Medical Robots

Robots employed in medicine and medicinal institutes. First & foremost surgical treatment robots. Also, a number of robotic directed automobiles and perhaps lifting supporters.

D. Service Robots

These Robots could be various data collecting robots, robots prepared to exhibit technologies or robots employed for research, etc.

E. Military Robots

Military robots are autonomous robots or remote-controlled mobile robots designed for military applications, from transport to search & rescue and attack. Some such systems are currently in use, and many are under development.

F. Entertainment Robots

These types of robots are employed for entertainment. This is an extremely wide-ranging category. It begins with model robots such as robosapien or the running photo frames and concludes with real heavy weights like articulated robot arms employed as movement simulators.

G. Space Robots

Space robots are the general purpose machines that are capable of surviving the rigors of the space environment, and performing exploration, assembly, construction, maintenance, servicing or other tasks.

H. Hobby and Competition Robots

Hobby Robots generally created by students. Such as Sumo-bots, Line followers, robots prepared merely for learning, fun and robots prepared for contests.

VI. FUTURE SCOPE

The advantages of robotics include heavy-duty and tedious jobs but despite these advantages, there are certain skills to which humans will be better suited than machines in some near future and the question is how to achieve the best combination of human and robot co-operational skills. The combination of human and robot skills need the development of new approaches and standards to guarantee the safety of the "man-robot merge". In future, co-operation between robots and humans will be diversified, with robots increasing their autonomy and human-robot collaboration reaching completely new level. Current approaches and technical standards [14] [15] aiming to protect employees from the risk of working with collaborative robots will have to be revised.

VII. CONCLUSION

Robotics is a broad field and everyday there is a pioneering invention in the field. Robots were invented for assisting humans in various sectors. Human beings are better suitable for multifaceted, imaginative, adaptive jobs, and robots are good for dreary, recurring menial tasks, permitting human beings to do the productive and hard thinking jobs, whereas a robot is employed for substituting humans for various recurring tasks or entertainment to make living more expedient.

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