

TECHNOLOGY

Robots Help World's Work

On moon, under oceans, in atomically "hot" nuclear reactors and laboratories, on factory production lines, and even in auto traffic, automatic devices are coming into use.

By WATSON DAVIS

► "LOOK, MAMMA, no hands!" Mother was horrified when she saw her darling daughter riding on a bicycle steering it by changing her weight from side to side. That was very elementary, and a generation ago.

In the present era of sports cars and "hot rods" when bicycle riding is very old fashioned, the twitch of a muscle in Los Angeles experiments holds the promise of steering automobiles. An armless driver is expected to guide a vehicle in the future even through complicated traffic. Perhaps even a wink of an eye could function in the same way.

Automatic Guidance

Automation has not yet entered everyday service with the possibility of substituting for the marvelously expert reactions and judgments that every automobile driver makes almost every second that he is on the road. But cars and highways are being designed to allow driving on special highways without use of human hands or even eyes. Whether such electronic automatic guidance will be in practical use in the near future is a question.

To replace human hands, feet, and muscles, technology has developed a large variety of automation mechanisms that duplicate the function of age-old human skills.

There are robots doing everyday work in laboratories and factories, extending control into places too radioactively "hot" or too remote for human hands and arms.

Substitute for Hands

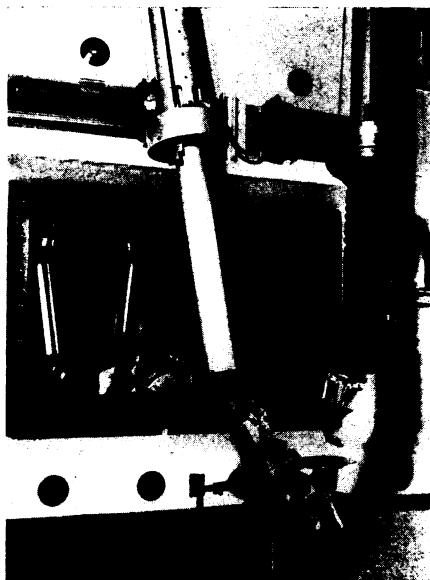
Robots, tough and precise, are in training to land on the moon and sample what is there. Mechanical and chemical sense organs will investigate and report what they find via electrical signals telemetered to earth.

On the bottom of the sea too, many fathoms deep, a mechanical arm extending from a diving vehicle, can be manipulated to pick up specimens, guided by television.

At almost every atomic "show" there are remotely controlled hands of a master-slave manipulator such as is used to handle highly radioactive materials in laboratories and within reactors and other atomic energy locations that are dangerously radioactive. The operator by manipulating devices with controls very similar to those that his hands would use if he were actually handling the objects, can cause the "slave" device to do all the things that could be done with his own hands. In the atomic shows for the public, the two ends of the manipulator

are in open air so they can be easily seen. When in actual use, the remote control device would be sealed off to shield the operator from radiation. The "slave" apparatus can be guided by viewing it through thick glass windows or remotely by television.

Many of these remote controlled devices are delicate scientific instruments. But others do heavy work needed in repairing the radioactive interiors of large atomic reactors. At the Babcock & Wilcox Company's research and development center in Alliance, Ohio, there is a fork with two arms that can easily lift a half-ton object while a third arm duplicates most functions of the human wrist and arm. There is a pipe welder that can make a fine six-inch weld in 30 seconds and a pipe cutter that can sever a ten-inch pipe. The technicians that control such



Picker X-Ray Corporation

TO HANDLE highly dangerous radioactive material, like cobalt-60, atomic by-product, scientists have the use of remotely controlled "hands" of a master-slave manipulator like the one shown in this picture. The technician, working behind the safety of a liquid-filled double-paned glass five feet thick, guides the cleverly contrived device, which can pick up a disk of radioactive cobalt, put it in a stainless steel cup, seal it with an automatic welding machine and drop it in a heavy lead container for its journey to medical or industrial users.

instruments are protected by a four-foot-thick lead glass window and aided also by a television system. Such robots are required to maintain reactors which use circulating liquid metal as the atomic fuel.

Not all the mechanical robots do their work in a hazardous situation. One portable automatic mechanical hand called a "Fleximan" is programmed mechanically to work on small production lines where the quantity of items made and frequent changes in the product have heretofore made automation impractical and overly expensive. It can feed drill presses, assemble parts, feed conveyors, run parts through punch presses and welders and do many repetitive chores. In demonstration stunts manufacturers have programmed it to deal cards in a bridge game, light cigarettes and pick up pins.

Engineers have dreamed of having roads and automobiles which steer themselves safely and expeditiously along the highways without collisions and traffic jams. This is theoretically possible through the use of automated roads and arranging it so that the control apparatus is installed in every automobile and truck that uses them.

Railroads Run Automatically

For railroads and subways where the tracks are more clear and unimpeded by cross traffic, automatic trains are possible. A subway train which literally runs itself, makes the proper stops and travels at the predetermined speeds has already been tested in the New York subways. For many years the railroads of the nation have had automatic train control which does keep a train from entering a track which is already occupied by another train, a procedure which was developed to prevent wrecks and disasters.

Many of the airplanes on our transport routes fly themselves, to a large extent, by means of automatic pilots. When altitude has been attained, the robot can take over. The pilot is there to see that everything goes well but he does not have to control manually the giant vehicles in the air except to change their direction in an emergency. There are even devices which do a limited amount of takeoff and landing of airplanes.

Electronic Highway

An electronic highway with an automatic pilot for cars and control for traffic safety has been demonstrated but not put into practice. The Radio Corporation of America in cooperation with General Motors showed that it is possible to drive, automatically, specially equipped cars on a test track. The cars accelerate and brake and maintain safe spacing between each other in response to electrical signals from the road. The driver can be talked to by a control center, which tells him of intersections that he is approaching, roadside service areas or hazardous conditions ahead. Such an automated high-

way, if it were introduced, would necessitate all the cars using it to be equipped with an automatic pilot. The experts feel that this will come first on special truck highways between points of great population density and business.

One approach to automation is a system which has been worked out by Delco Radio for broadcasting messages to ordinary car radios from transmitters along the road. Traffic information is provided in this way when it is needed. This has been tried out on test stretches on the Kentucky Turnpike just south of Louisville through the cooperation of U.S. Bureau of Public Roads, the Georgia Institute of Technology and the Kentucky Highway Department.

Mechanisms on Moon

For travel in space, whether the rockets and satellites and other space vehicles carry people or scientific apparatus, automatic controls are widely used. The moon will be conquered from the standpoint of scientific knowledge, first by an inanimate visitor from the earth; even if and when men land,

much of their operation will be directed from a planned and programmed procedure, perhaps directed from the earth in the event that an emergency arises.

A great variety of mechanisms and devices, both electronic and mechanical, are utilized in applying automation. Extremely precise gyroscopes, compact and miniaturized transistors and other electronic control apparatus play a large role in some of the automation. Other devices rely largely upon mechanical as well as electronic methods of operation.

Behind some of the more elaborate automatic devices there are computers, large and small, that do almost everything but think. The human brain is still supreme even though in many cases the work of human muscles and reflexes is supplanted by the automatic devices. People have to think through and create automation, both in the design of the instruments and in planning. Human beings must determine what is to be done and when the devices shall operate. Mechanisms labor under man's control.

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SPACE

Sick Astronauts Doctored

► WHAT WOULD space doctors do if an astronaut came down with measles during a long space flight?

Or how could a moon explorer who fell and broke his leg 239,000 miles from earth be treated?

Dr. Charles A. Berry of the National Aeronautics and Space Administration's Manned Spacecraft Center, Houston, Texas, told SCIENCE SERVICE that such occurrences are possible but not expected during future space missions.

It is impossible to keep astronauts in complete isolation before a flight, Dr. Berry said. A technician coughing on the launch pad, for instance, might pass on a germ which could result in a space explorer coming down with a cold a week later.

NASA is therefore planning ways of meeting such contingencies. These plans include turning the spacecraft around and returning to earth in severe cases. Future vehicles also may be equipped with emergency medical equipment. It is also possible that doctors may be trained as astronauts for 30- to 60-day lunar missions, Dr. Berry added.

Communicable disease is not a serious problem since people close to astronauts before flights will be checked closely, he said. However, "as we look at mission durations of up to 14 days, it is obvious that some communicable diseases could develop in flight if the astronauts were exposed during the preflight preparation period."

NASA may equip lunar landing vehicles with such provisions as splints, Dr. Berry said, but first they want to know more about the lunar surface and what type of gait a man in a spacesuit would have.

During a lunar mission, the blood pressure, respiration, body temperature and heart beat of each astronaut will be sent

back to earth, where the information will go through a computer in the mission control center before going to Dr. Berry.

"What we are really interested in is how much function does the brain have in space?" Dr. Berry commented. "All we monitor is a means of getting at that."

Dr. Berry, who is chief of medical programs at the Manned Spacecraft Center, was interviewed at a meeting of the American Astronautical Society in New York. He also revealed that NASA hopes to get a good system of receiving electroencephalogram data showing the electrical activity of the brain during space flight.

Methods of taking EEG traces may be tried during two-man Gemini flights "but we don't have a good system yet. . . . The real problem is that you cannot burden an astronaut by tying electrodes on all over the place."

The NASA scientist also stated:

While pills for motion sickness and fatigue have been the only medication used so far in flight, "drugs do have an emergency role in the space flight environment." Injectors containing stimulants and anti-shock medication were carried on some flights but not used.

The question of what causes post-flight orthostatic hypotension, or reduction of blood pressure after emerging from spacecraft, remains unanswered. Both Astronauts Walter Schirra and L. Gordon Cooper Jr. experienced changes in blood pressure and heart rate after standing up, Dr. Berry said, and these persisted for some 7 to 19 hours after landing.

In case one member of a three-man Apollo crew is incapacitated before a mission, NASA plans to replace the entire crew in order to maintain "crew integrity."

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Computer Simulates People With Problems

► AN ELECTRONIC COMPUTER has been designed that can simulate the actions of a small group of people as well as their feelings.

Called Homunculus, the system was designed by John T. and Jeanne E. Gullahorn of the computer institute for social science research of Michigan State University, East Lansing. It will be used to provide concrete bases for psychological theories.

The system is programmed to deal with a number of "persons," Mr. Gullahorn told the Spring Joint Computer Conference in Washington, D. C. Each "person" is provided with various personality and ability traits.

In addition to a history of past action, the "personality" includes job proficiency, skill in social situations, and positions in various groups, such as clubs, the family and the office staff.

The computer also provides each "person" with a set of needs and values, including personal status symbols.

Each person has a memory of past experiences involving the other group members, as well as the ability to tell good from bad and to associate given action with certain responses.

In one example, the computer simulated the staff of a civil service office. A number of workers were engaged in the same job, but some were better at it than others. As the workers became more proficient, they received more requests from co-workers for assistance.

Each participant in a request-relationship had to consider both benefits and losses. The worker asking for help would gain the assistance but would lose by admitting his inferiority. The other person would gain from being asked and from the resulting gratitude, but would lose time from his own job.

The next task in line for Homunculus, Mr. Gullahorn told SCIENCE SERVICE, is to consider the interaction of two computer personalities that disagree on whether or not novelist Herman Melville's character Billy Budd should have been hanged.

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Computer 'Caveman' Has Compressed Air Muscles

► A "CAVEMAN" is on exhibit at the New York World's Fair, but he is more modern than anyone living today.

Created by Walt Disney for the Ford Motor Company display, his body is honeycombed with plastic tubes instead of muscles. An electronic computer, programmed with all the motions of his lips, tongue, jaw, brow and hands, triggers blasts of compressed air through the tubes, operating his "muscles."

In this newly developed technique, called Audio-Animatronics, the computer also controls a tape-recorded voice, synchronized with mouth movements.

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