

Before using a robot be aware of – ROBOT SAFETY

- **OBJECTIVES:**
 - **BE ACQUAINTED WITH ROBOITIC SAFETY.**
 - **UNDERSTASND SFETY STANDARD.**
 - **RECOGNISE SAFETY RELIABILITY.**
 - **BE FAMILIAR WITH HUMAN FACTOR ISSUES.**
 - **BE AWARE OF SAFETY SENSORS AND MONITORING.**
 - **REALIZE SAFEGAURDING.**
 - **PERCEIVE THE IMPORTANT FACTORS OF TRAINING.**
 - **APPREHEND SAFETY GUIDELINES.**
 - **UNDERSTAND DEFINITIONS.**

ROBOTS AND CONVENTIONAL MACHINERY

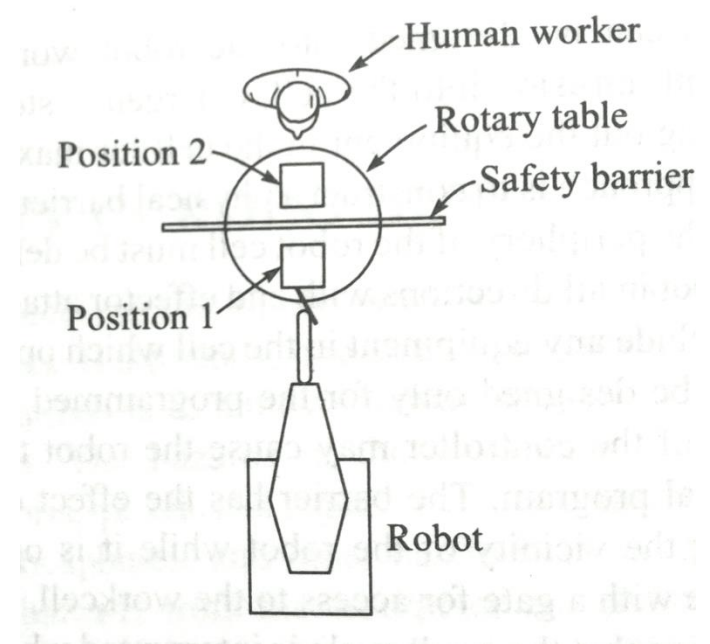
THREE MAJOR DIFFERENCES BETWEEN ROBOTS AND CONVENTIONAL MACHINERY

- SPEED OF MOVEMENT.**
 - PREDICTABILITY OF MOVEMENT.**
 - HAZARD ZONES.**
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- IN CONVENTIONAL MACHINERY HAZARD ZONES MAY BE DIFFICULT TO RECOGNIZE, BUT ARE FIXED WITH TIME.**

 - ALSO THE MAIN DIFFERENCE BETWEEN CONVENTIONAL MACHINERY AND ROBOT IS THAT A ROBOT CAN BE :**
 - PROGRAMMED TO DO DIFFERENT JOBS.**
 - REACT TO CHANGES IN THE PROCESS, EVEN MAKING DECISIONS FROM A LIMITED NUMBER OF CHOICES.**

CAUSES OF ACCIDENTS

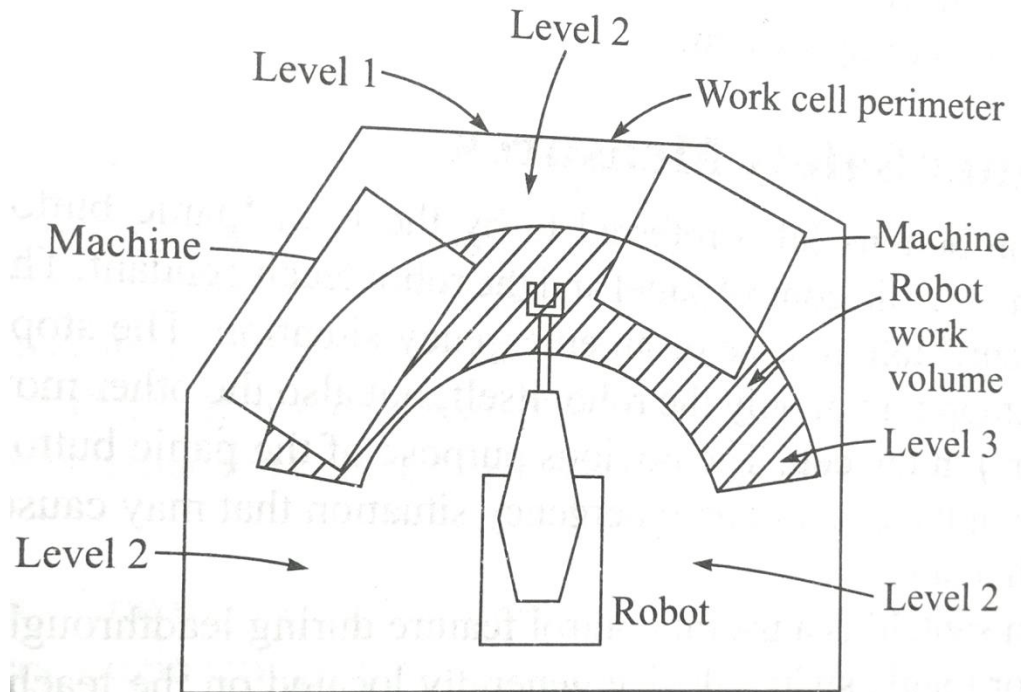
- **ENGINEERING DEFICIENCY**
- **LACK OF PROPER PROCEDURES**
- **INADEQUATE PROGRAMMING**



- **EMERGENCY STOP SWITCHES MUST APPEAR ON THE CONTROL PANEL AND ALSO BE ADDED TO THE PENDANT USED IN THE TEACH MODE**
- **COMPREHENSIVE INSTRUCTION AND OPERATION PROCEDURES MUST ALSO BE INCORPORATED THROUGH TRAINING PROGRAMS.**

Three safety levels

- Level 1 : perimeter intrusion -
- Level 2 : Inside work cell
- Level 3: Inside work volume



HUMAN FACTOR ISSUES

- **BESIDES THE SIZE OF A ROBOT'S WORK ENVELOPE, ITS SPEED, ITS PROXIMITY TO HUMANS, AND INTERACTION WITH OTHER MACHINERY, :**
 - THE LAYOUT OF CONTROL PANELS.
 - TEACH-PENDANT ACCURACY.
 - PERSONNEL TRAINING
 - BARRIER GUARDS.
 - SAFETY DEVICES.
 - INTERLOCKS.
 - WARNINGS
- **IN ADDITION HUMAN FACTOR ISSUES SHOULD INCLUDE EVALUATION OF A ROBOT WORKSTATIONS WHEN AN OPERATOR ENTERS THE WORKSTATIONS FOR MAINTENANCE, PROGRAMMING, AND THE LIKE.**

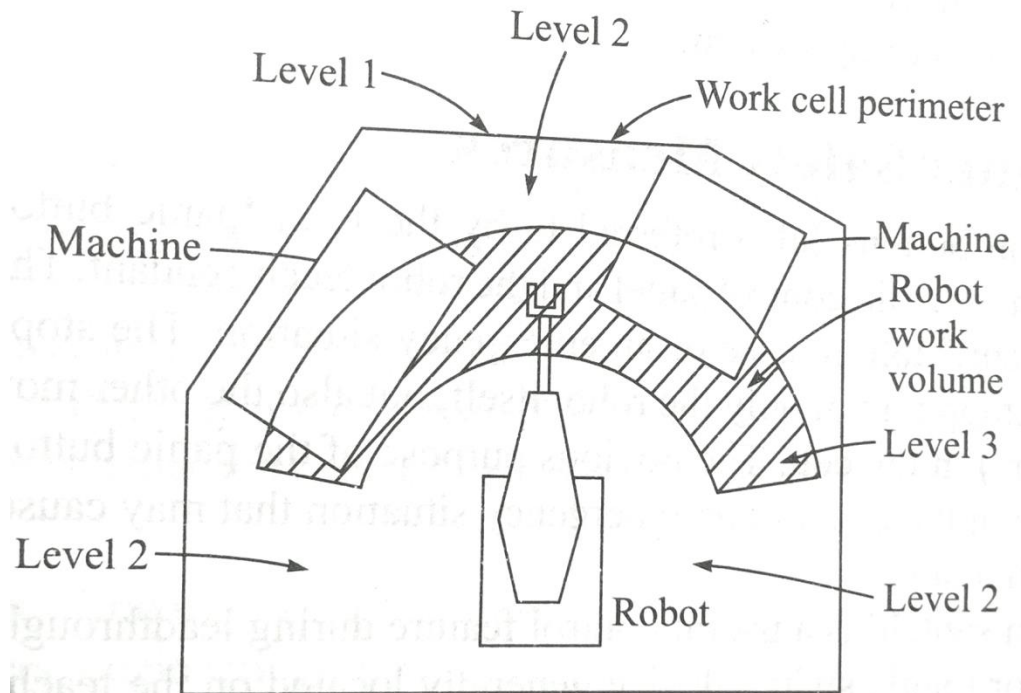
- **Implementing safety:**

1. **TO ERECT A PHYSICAL BARRIER AROUND THE ENTIRE PERIMETER OF A ROBOT'S WORK ENVELOPE**
2. **PRESSURE SENSITIVE FLOOR MATS** --- ARE AREA PADS PLACED ON THE FLOOR AROUND THE WORKCELL THAT SENSE THE WEIGHT OF SOMEONE STANDING ON THE MAT. THESE CAN BE USED FOR EITHER LEVEL1 OR LEVEL2 SENSING SYSTEMS.
2. **LIGHT CURTAIN** --- CONSISTS OF LIGHT BEAMS AND PHOTSENSITIVE DEVICES PLACED AROUND THE WORKCELL THAT SENSE THE PRESENCE OF AN INTRUDER BY AN INTRRUPTION OF THE LIGHT BEAM
3. **LIMIT SWITCHES – on doors**
4. **VISION SYSTEM – sudden motion**
5. **LASERS -**

- **Procedure to be followed:**
 1. **COMPLETE SHUTDOWN OF THE ROBOT UPON DETECTION OF AN INTRUDER.**
 2. **ACTIVATION OF WARNING ALARMS.**
 3. **REDUCTION OF THE SPEED OF THE ROBOT TO SAFE LEVEL.**
 4. **DIRECTING THE ROBOT TO MOVE ITS ARM AWAY FROM THE INTRUDER TO AVOID COLLISION.**
 5. **DIRECTING THE ROBOT TO PERFORM TASKS AWAY FROM THE INTRUDER.**

Three safety levels

- Level 1 : Physical barrier, limit switch, laser – **flashing light**
- Level 2 : **alarm** – laser, light curtain.
- Level 3: **stop robot** – active floor mat, vision -



SAFEGUARDING AGAINST COMMON ACCIDENTS

- **ACCORDING TO THE NATIONAL SAFETY COUNCIL(1991) THE PRINCIPAL HAZARDS ASSOCIATED WITH ROBOTS ARE AS FOLLOWS:**
 - 1. BEING STRUCK BY A MOVING ROBOT WHILE INSIDE THE WORK ENVELOPE.**
 - 2. BEING TRAPPED BETWEEN A MOVING PART OF A ROBOT AND ANOTHER MACHINE, OBJECT, OR SURFACE.**
 - 3. BEING STRUCK BY A WORKPIECE, TOOL, OR OTHER OBJECT DROPPED OR EJECTED BY A ROBOT.**

SAFETY GUIDELINES

- **THE UNEXPECTED ROBOT MOVEMENTS ARE THE CONCERN OF EMPLOYEES FOR OBTAINING FURTHER GUIDELINES ON ROBOTICS SAFETY.**
 - 1. IF THE ROBOT IS NOT MOVING, DO NOT ASSUME IT IS NOT GOING TO MOVE.**
 - 2. IF THE ROBOT IS REPEATING PATTERN, DO NOT ASSUME IT WILL CONTINUE.**
 - 3. ALWAYS BE AWARE OF WHERE YOU ARE IN RELATIONSHIP TO THE POSSIBLE POSITIONS THAT THE ROBOT MAY REACH.**

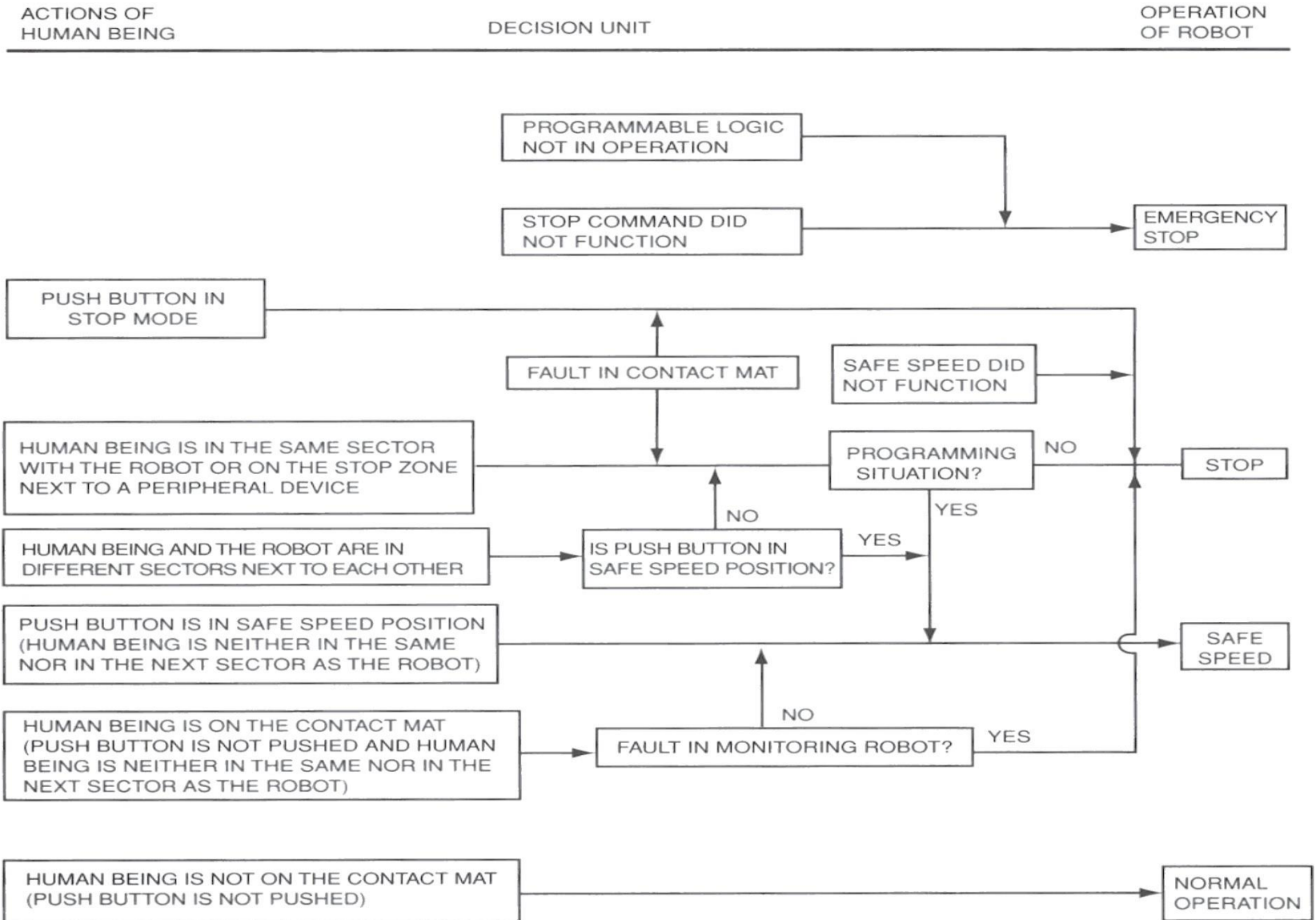


Figure 11.5.2 Robot safety system operation

Programming for safety

- All programs for robotic applications must contain safety precautions.
- Monitoring sensors.
- Interrupts in the controllers for automatic stopping.
- Robot interaction with environment should be carefully designed.

SUMMARY

- **SAFETY IS AN IMPORTANT COMPONENT IN INDUSTRIAL AUTOMATION.**
- **ROBOT SAFETY DEPENDS ON THE SIZE OF THE ROBOT'S WORK ENVELOPE, ITS SPEED, AND ITS PROXIMITY TO HUMANS.**
- **SAFETY SENSORS AND MONITORING PROVIDE THE CAPABILITY OF THE WORKCELL CONTROLLER AND ITS SENSORS TO MONITOR THE OPERATION DURING UNSAFE CONDITIONS IN THE CELL.**
- **SAFEGUARDING IS THE PREVENTION OF INJURY OR ACCIDENT IN THE WORKPLACE.**
- **TRAINING IS A MAJOR FACTOR IN THE SUCCESSFUL IMPLEMENTATION OF ANY ADVANCED TECHNOLOGY IN A COMPANY OR OPERATION.**
- **SAFETY GUIDELINES HAVE BEEN DEVELOPED BY RESEARCHERS PERTAINING TO SAFETY ISSUES IN ROBOTS TO REDUCE OR ELIMINATE ACCIDENTS IN A PRODUCTION ENVIRONMENT.**