SPATIAL DECISION SUPPORT SYSTEM FOR INDUSTRIAL ROBOTS

G.Sriram[1] ,P.Amirtha Ganesh[2]

[1]B.E.Geoinformatics, College Of Engineering Guindy

[2]B.E.Industrial Engineering, College Of Engineering Guindy

ABSTRACT: Requirement for industrial robots: Industrial robots must be capable of navigating through obstacles and moving objects. In this regard it must be able to make spatial decisions (decisions that involve taking geography of the area into consideration) for effective navigation and work. Our paper is about building a spatial decision support system which will automatically take into account all the decision making processes and help in making effective spatial decisions. We make thematic maps of the area and feed it into GIS software. The software is programmed to query all the thematic layers with position as the key attribute. This allows the robot to decide which path to take and how to do the given work with best efficiency. The spatial commands will make the robot do the work in double quick time.

1. INTRODUCTION

Industrial robot

An industrial robot is defined by ISO as an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes. The field of robotics may be more practically defined as the study, design and use of robot systems for manufacturing (a top-level definition relying on the prior definition of robot).

Typical applications of robots include welding, painting, assembly, pick and place (such as packaging, palletizing and SMT), product inspection, and testing; all accomplished with high endurance, speed, and precision.

GIS:

A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. The acronymGIS is sometimes used for geographical information science or geospatial information studies to refer to the academic discipline or career of working with geographic information systems and is a large domain within the broader academic discipline of Geoinformatics.

A GIS can be thought of as a system that provides spatial data entry, management, and retrieval, analysis, and visualization functions. The implementation of a GIS is often driven by jurisdictional (such as a city), purpose, or application requirements. Generally, a GIS implementation may be custom-designed for an organization. Hence, a GIS deployment developed for an application, jurisdiction, enterprise, or purpose may not be necessarily interoperable or compatible with a GIS that has been developed for some other application, jurisdiction, enterprise, or purpose. What goes beyond a GIS is a spatial data infrastructure, a concept that has no such restrictive boundaries.

In a general sense, the term describes any information system that integrates stores, edits, analyzes, shares, and displays geographic information for informing decision making. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations. Geographic information science is the science underlying geographic concepts, applications, and systems.

DECISION SUPPORT SYSTEMS

A Decision Support System (DSS) is a computer-based information system that supports business or organizational decision-making activities. DSSs serve the management, operations, and planning levels of an organization (usually mid and higher management) and help to make decisions, which may be rapidly changing and not easily specified in advance (Unstructured and Semi-Structured decision problems). Decision support systems can be either fully computerized, human or a combination of both.

While academics have perceived DSS as a tool to support decision making process, DSS users see DSS as a tool to facilitate organizational processes.Some authors have extended the definition of DSS to include any system that might support decision making. Sprague (1980) defines DSS by its characteristics:

1. DSS tends to be aimed at the less well structured, underspecified problem that upper level managers typically face;
2. DSS attempts to combine the use of models or analytic techniques with traditional data access and retrieval functions;
3. DSS specifically focuses on features which make them easy to use by noncomputer people in an interactive mode; and
4. DSS emphasizes flexibility and adaptability to accommodate changes in the environment and the decision making approach of the user.

DSSs include knowledge-based systems. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, documents, and personal knowledge, or business models to identify and solve problems and make decisions.

Typical information that a decision support application might gather and present includes:

- inventories of information assets (including legacy and relational data sources, cubes, data warehouses, and data marts),
- comparative sales figures between one period and the next,
- projected revenue figures based on product sales assumptions.\

SPATIAL DECISION SUPPORT SYSTEM:

A spatial decision support system (SDSS) is an interactive, computer-based system designed to assist in decision making while solving a semi-structured spatial problem. It is designed to assist the spatial planner with guidance in making land use decisions. A system which models decisions could be used to help identify the most effective decision path.

An SDSS is sometimes referred to as a policy support system, and comprises a decision support system (DSS) and a geographic information system (GIS). This entails use of a database management system (DMS), which holds and handles the geographical data; a library of potential models that can be used to forecast the possible outcomes of decisions; and an interface to aid the users' interaction with the computer system and to assist in analysis of outcomes.

2. METHODOLOGY:

We are building a spatial decision support system for Industrial robots which will enable the robots to take both spatial and non spatial decisions. The industrial robots must be as accurate and efficient as possible. This is achieved by taking into account all the decision affecting components and making a thematic map of the same. The thematic map is fed into GIS software and this is included into the robotic chip. The robot is enabled to make spatial queries the result of which will form the emphasis through which decisions are taken by the robot.

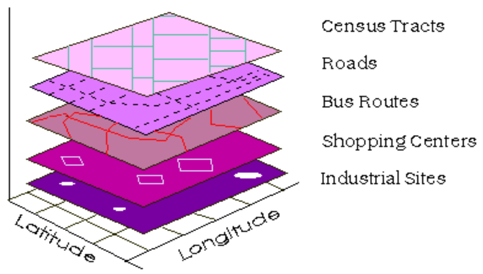

Fig1:Thematic layers inGIS.

3. BUILDING A SPATIAL DECISION SUPPORT SYSTEM:

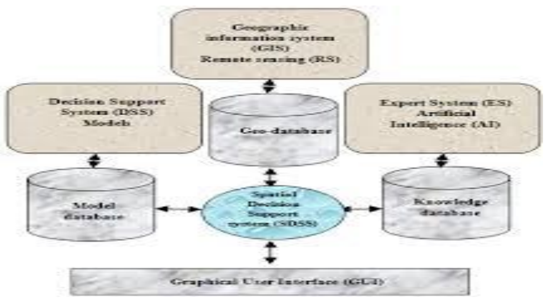

Fig2: Components of a spatial decision support system.

As shown in figure 2 , we have to use both spatial and non spatial data in making a spatial decision support system. These two data are stored in a database and tools are added to access these data effectively. A graphical user interface is present to view the data and this leads to the formation of decision models that help in decision making.

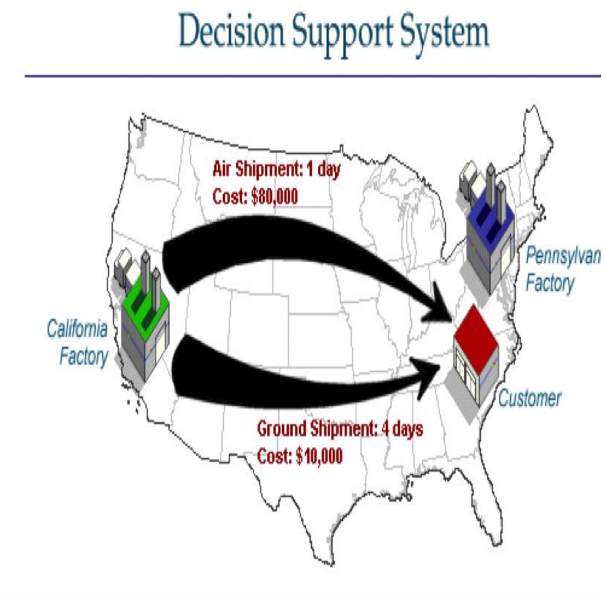

Fig 3: Spatial and non spatial data being linked.

In the above diagram spatial data(location of factory) and non-spatial data(cost of shipment) is being linked in a GIS software.

RMT Robotics

ADAM autonomous delivery and manipulation AGV

Fig4:ADAM allows companies to deliver the needed quantities of material, when and where they are needed—basic principles of lean manufacturing. But, even in 2012, many companies still use manual process for the transportation of raw and work-in-process material between an automated storage and retrieval system and an automated production machine. When you connect these 'islands of automation,' you not only reduce labour but, more importantly, you also improve product quality and increase throughput.

This system can be enhanced considerably by having a spatial decision support system for the robots.

4. SPATIAL DECISION SUPPORT SYSTEM & INDUSTRIAL ROBOTICS

The Industrial robot may have to move materials from one location to another.

The SDSS will have a thematic map of the industry . The software will also contain map of the materials present. These are linked by the attribute of location. Once the source and destination are given, the material will be moved by the robot to the required location in best possible route.

5. PATH PLANNING:

Fig5: Path planning

The industry is photographed and a thematic map of the same is given as input in the GIS software. This allows the robot to have a path plan by which it will be able to move objects from one place to another. The robot takes into account the start location, end location the obstacles present and the time taken to move from one place to another. Using all this information it comes up with a plan which is most accurate and involves less time consumption.

Total Industrial robot process:

Wielding:

- Decisions to be taken:
- The first consideration for mild steel welding, which is the predominant material joined, is **deciding what welding process to use**.
- Shielded metal arc (SMA), gas tungsten arc (GTA), or gas metal arc (GMA) welding are the three processes usually considered
- **Select the Proper Filler Metals**
- Selecting the proper filler metal requires an understanding of the mechanical properties desired and weld appearance considerations
- **Maintaining Welding Parameters** After selecting the welding process and filler metal, the proper welding parameters must be maintained. Wire feed speed, voltage, and travel speed are the key parameters to set and maintain. Welding current is a dependent variable and is controlled by wire feed speed and electrode extension.

Assembly& Product inspection

- These robots have to acquire components and use them to assemble vehicles etc.
- Decisions to be taken:
- What components to acquire.
- How the assembly must be done.
- Are the products of the required quality.
- Are the materials arranged in a proper order.

MOVING OBJECTS

- These robots have to make spatial decisions.
- Where to pick an object and where to place it.
- How the material must be moved.
- How it can be moved with best accuracy and least time.
- Confluence of spatial and non spatial decision must be taken.

6.CONCLUSION:

- For the first time we have a database that is able to process both spatial and non-spatial data simultaneously.
- This will enable the robot to take spatial decisions in addition to non spatial decisions.
- Unnecessary transportation breakdown time is reduced.

Thus the overall accuracy and efficiency of Industrial robots are significantly enhanced

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