

CAR NAVIGATION SYSTEM (MAPPING SYSTEM)

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ABSTRACT

The car navigation system naturally links with the Global Positioning System (GPS). It is increasingly being used by the road traffic users to help them in navigating to their destination. In this research, the basic operations of car navigation are being discussed in detail. Besides that, this research also discussed the fabrication of car navigation system by having to take the Garmin Car Navigation product as the basic sample. By referring to the academic literature and the internet resources, this research reveals the expected fabrication process of a car navigation product. This knowledge is a small step in understanding the basic operation concepts and assembly of a car navigation system.

Keywords

Car navigation system, Garmin, Process, Production

1.0 INTRODUCTION

The car navigation system also considered as a satellite navigation system. It will receive signal from satellites and identify the vehicle's position and direction by combining that data with information obtained from various on board sensors. The car navigation system naturally links with the Global Positioning System (GPS). GPS is a navigation system that installed in the car and it is operates via the network that links with the satellite. Recently, the majority of it is used for commercialization purpose however it is for military and marine in advances. The basic function of GPS utilizes for gain any information about location and weather condition in any places and any times. The car navigation product that we choose is Garmin Nuvi GPS product.

Base on the reference to similar products, we have assumed and conclude about the Garmin Car Navigation product is be produced with assembly process. There have three important parts in Car Navigation product which be conduct and assembly with different process. Three main part of Car navigation product consist of printed circuit board (PCB), liquid crystal display (LCD) and casing. The manufacturing of casing is produce by injection molding process. Besides, the Printed circuit board is involving with surface mount technology to solder all needed electronic components. The anisotropic conductive adhesives (ACA) are mostly used for connecting the electrically conductive areas on a LCD to a PCB.

For the production process, that will explain and conclude the assembly line of the Garmin GPS product. The transfer line of the production is involved the conveyor system. At the last part is the product storage system of the Garmin GPS product.

2.0 LITERATURE REVIEW

2.1 Product Selection

There are many types of GPS models had been introduced to the market gradually. We have select the Garmin Nuvi GPS product as our assignment product which is famous in car Navigation system. Garmin is a leading GPS product in Malaysia compare to other brands. Besides, Garmin is the world's best-selling GPS. The Garmin Nuvi GPS product is introduced by Garmin International Inc. Garmin International Inc was established at 1989 in Switzerland by Gary Burrell and Min Kao.

Garmin is the leader in GPS innovation. They had established many "firsts" in the last decade-from landing the first non-precision approach using a general aviation GPS and introducing the world's smallest GPS for the outdoor enthusiast. Garmin design the GPS units with the customer in mind by include the simple operation, logical menus, smart features, and easy-to-understand instructional manuals of the units. Garmin have enabled to develop GPS receivers that locate satellite signals quickly, maintain a lock on those signals, track the location wherever we go and extend the life of batteries through innovation. They have also built into their receivers the processing power that you need for instant updates, smooth scrolling and real-time moving map capabilities.

With technology getting advances, Garmin Nuvi GPS 2013 products also have improved. It has highly accurate map data and turn-by-turn directions that sound as if spoken by a friend. Big, bright screens allow you to focus on the road. Garmin also provide steady, dependable information relies on satellites. Garmin Nuvi has constantly added some features to contract customer such as electronic maps, voice activated navigation that respond intelligently to our commands, Bluetooth compatible, smartphone link compatible, powered magnetic mount to align the device perfectly and hold it securely and display more driving information on the map. The features added are based on different series of the product Garmin Nuvi. There are three series of Garmin Nuvi GPS product which are essential,

advanced and prestige series. Hence, the series of product selected is absolutely depends on customer requirement.

2.1.1 The Functions included in Garmin GPS

- GPS device will send the coded radio signal to the earth.
 A GPS receiver's device job is to locate four or more of these satellites, and it figure out the distance to each, and it use this information to deduce its own location. This operation is based on a simple mathematical principle called trilateration. Trilateration in three-dimensional space can be a little tricky, so it will start with an explanation of simple two-dimensional trilateration.
- Mark waypoint function.
 The mark waypoint allows you to mark and record your current location as a waypoint and displays a name for that waypoint and a waypoint symbol. You can mark your current location from anywhere. And you can set a location name at the area.
- Find menu
 The find menu feature helps you to find of searching for cities and place which included in the GPS map. You can even search for point of interest, addresses and intersection. Waypoint that you save into the device also can find it at find menu.
- Track log function
 The track log function creates an electronic trail on the map page as you travel about and is referred to as a track log. A track log contains information about point along its path, including time, position and elevation. It also record your movements for a given time and place.

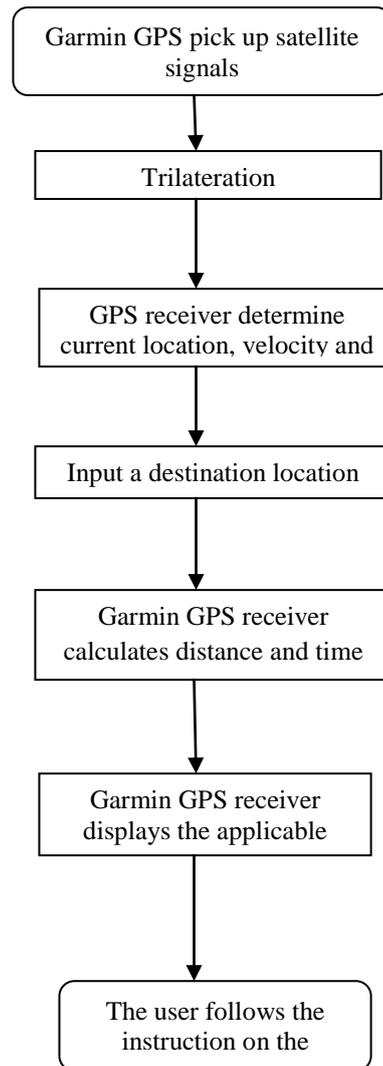


Figure 1: Flow of information for Garmin Nuvi

2.1.2 How Garmin Nuvi mapping system works

First, the Garmin Global Positioning System (GPS) receives the satellite signals and uses them to triangulate the user's location through trilateration process. Next, the Garmin GPS will determine the user current location, velocity and time. If the user set the specific destination to the Garmin GPS device, the GPS receiver will calculate the distance and time to arrive the new destination. Then, the Garmin GPS will show the detail on the screen and the users just follow the mapping system go for another new destination.

2.2 Process

2.2.1 Manual operation and automated system

2.2.1(a) Printed Circuit Board Automated system

Printed Circuit Board (PCB) in Car navigation product has involves into automated system in manufacturing workstation. Process of solder resist is performed before assembly of each electronic circuit onto PCB. The solder paste is automatically added and painting in the surface of PCB by the machine.

After solder resist process, the conveyor utilized for transmit the assembled PCB to the next section, that is assembly system or pick-and-place processes. In the assembly system, surface mount technology (SMT) adopts for mounting each electronic circuit onto the surface of PCB automatically by insertion machines.

After SMT process, the process of wave soldering is carried out for fixed each circuit which placed in the surface of PCB. The molten solder is store in a solder reservoir. When the Printed Circuit Board is moved forward and simultaneously the bottom of the PCB will touch directly with the molten solder and soldering process is done. Therefore, PCB soldered will transmit into next station for inspection by using optical sensor.

**2.2.1 (b) Liquid crystal display (LCD)
LCD Assembly process**

According to Brackell. P(2000), anisotropic conductive adhesives (ACA) are mostly used for connecting the electrically conductive areas on a LCD to a PCB via a flexible circuit with conductive tracks. As stated by Brackell. P(2000, p.49), “Note that many display assemblies are manufactured in Asia and supplied with the display and flex already attached, leaving just the connection of the flex to the PCB.” ACA process require either one of manual operation and automated system. Equipment can vary from simple manual station (suited for small series production and laboratory environment) to fully automated inline system, for highest production rates.

As stated by Brackell. P(2000, p.46), “The two most common forms of adhesive are supplied either as a connector (flex) with adhesive already present in the foil or as an adhesive film.” Normally, anisotropic conductive film (ACF) is used for fine-pitch applications (6 mil, 0.15mm), as the particle size is smaller than those of heat seal connector (HSC). According to Wikipedia, ACF technology is used in chip-on-glass (COG), flex-on-glass (FOG), flex-on-board (FOB), flex-on-flex (FOF), chip-on-flex (COF), chip-on-board (COB) and similar applications for higher signal densities and smaller overall packages.

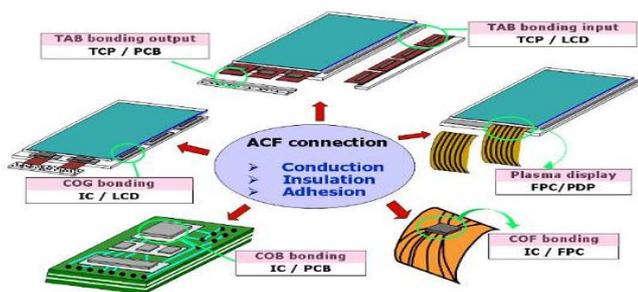


Figure 2: ACF technology

**2.2.1 (c) Casing
Automated System**

The Garmin Car Navigation products have conduct the process of casing to protect the components and LCD. The most similar product casing process through reference is casing of mobile phone. The casing is produce by injection molding process. The injection molding is full involving

automation system process. The material of the casing usually is polymer or thermoplastic.

In the injection molding process, polymer is heated to a highly plastic state and flow to flow under high pressure into a casing mold cavity where it solidifies and the molding is then removed from cavity. The process of injection molding is fully automation process because it is involve high temperature. In addition, the production of the casing is in mass production with faster cycle time. The automation process can consists of better production quality.

**2.2.2 Sensing
2.2.2(a) Printed Circuit Board (PCB)**

The Optical sensor plays as an inspection system that available to detect defection of Printed Circuit Board (PCB) of GPS Navigation for prevent quality error. It can assure the solder paste has coated onto the PCB properly and assure the electronic components are accurately assembly onto the PCB.

Whereas for the touch sensing in PCB, Garmin GPS also contains features of touch sensing for access and movement viable. Touch sensing that available human finger touch to the surface of sensor pad of the Car Navigation product that connects to the PCB. The touch sensing functioned when a sensor chip placed at the one end of the sensor pad that connect through a bond wire to the wedge bond that placed in another end onto the PCB.

**2.2.2(b) Liquid Crystal Display
Conductive Adhesives sensing**

IC Bonding Sensor System is a high resolution tactile sensor that captures the dynamic force/pressure distribution over the contact surface area during bonding processes. The IC Bonding Sensor System operates reliably in dynamic high temperature and pressure environment. Anisotropic Conductive Film (ACF) is used to make high density electrical connections for IC fabrication, flat screen assembly or whenever a large number of five-pitch electrical connections must be made. During ACF bonding, here a great deal of thermal and pressure transients when a hot blade or tool makes contact with materials being laminated. The IC bonding sensor system allow process operators to collect usable force/pressure data at actual bonding temperatures in real time for quick analysis and performance assessment of the equipment.

**2.2.2(c) Casing
Pressure sensors, robust pressure sensors and pressure transducer**

The robust pressure sensor is designed specifically for harsh and rugged environments of the injection molding process. Furthermore, pressure transducer is enables mold makers to gain precise and accurate data about how the tool is accurate data about how the tool is actually performing in production.

2.3 Production

In the production process of Garmin GPS Navigation product, we will describe about three production parts: assembly lines, transfer lines and product storage. Figure 1 and 2 are the guideline to describe Garmin GPS production line such as number of stations may be does not same with the figure 1 described.

2.3.1 Assembly line

The three components of GPS Navigation product are Printed Circuit Board (PCB), Liquid Crystal Display (LCD) and Casing. We assume automated assembly system used and it is in-line shape to the product in assembly line shown in figure 3 (Mikkil, P. G., 2008). With refer figure 3, we assume PCB is a starting base part transfer by conveyor system from left to right through each station. When PCB arrived in first station, some electronic circuit added at station will be inserted onto PCB by the robotic in the station. Then, it will passes to next phase for solder wave.

We also assume that the process of insert electronic circuit and solder wave may be repeated around three times in the following station. After process of inserted and solder wave had finished, soldered part will convey to the next station. We assume soldered part will cross storage buffer that is placed before it enter into next station shown in figure 4 (“Automated Production Lines”). Hence, soldered part will passes from storage buffer to the next station for integrated with the LCD and casing. In addition, LCD had been bonded with the front-frame of casing before added at the station. Therefore, LCD must links with the connector that had placed onto the PCB and subsequently integrated with back-frame of casing. The product Garmin GPS Navigation is done. Finally, completed product should transport into last station, Quality Control station responsible to ensure product Garmin is in good condition.

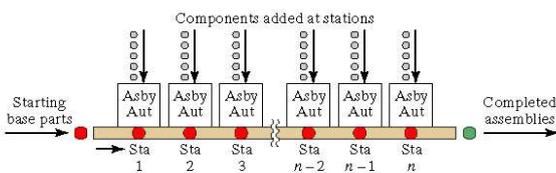


Figure 3: Automated Assembly System

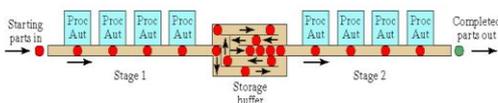


Figure 4: Storage Buffer

2.3.2 Transfer line

In transfer line, we assume it is in-line system configuration. The belt conveyor used for transport the part component to each workstation in a straight line. It passes starting base

part from station of process inserting electronic circuit and solder wave. Then, we assume component will transport by the belt conveyor to the storage buffer before enter into next station shown in figure 3.2. It will cross the storage buffer before enter next station. Storage buffer adopts to prevent starved of soldered parts occurred for supply in following station. Subsequently, soldered part from storage buffer is transport to the next station for insert PCB into casing and the casing had been bond with the LCD in advance. After it, finished product passes to Quality Control station for inspection. At the end of the transfer line, the finished products are transfer to the storage system.

We assume the product storage system of Garmin Car Navigation are often used for buffering or holding of reserved stock to ensure the components or products are enough to meet anticipated demand. Buffering storage is the process of storing “back-up” or reserve stock/ inventory to absorb expected variations in usage between the time reorder action is initiated and the first part of new orders is received in stock. In assembly area, storing work-in-process components for later production steps. In kitting area, storage used to provide an area for items that are commonly used together to be stored together. In production area, storage used to hold reserve components or tools for delivery to the production line as needed. Warehousing area also need storage to storing slow-, medium- and fast-moving products or materials for used when needed.

2.3.3 The product storage

The product storage of Garmin Car Navigation need to be considered as a important part to ensure the safety of product and it is on hand to meet the demands. Hence, a suitable storage systems management is required for this product. As we know, many area in a industry need storage systems to hold and secure material. In assembly are, storing work-in-process for later production steps. In kitting area, storage used to providing an area for items that is commonly used to be stored together. Storage used to holding reserves of components or tools for delivery to the production line when required in production area. Storage also used in staging area through holding items for further processing, packaging per shipping. Furthermore, warehousing area also need storage to storing slow, medium or fast-moving products for used when needed.

So, we are going to explain the type of product storage system used on Garmin Car Navigation. Through the source of internet, we assume the pallet rack system can be considered as a good choice for the product storage of Garmin. Rack systems are commonly made of steel and used to maximize the space of facility while simplifying inventory tracking. According to Murray, many companies store their products on pallets in the warehouse. Single-deep pallet rack of pallet rack system is a good selective for the Garmin product storage. Single-deep pallet rack also can be known as selective rack. It is the most common type of rack and provides the lowest-density storage of any pallet racking system. Single-deep pallet rack is popular because it permits unimpeded access to each pallet it stores.

It can also be configured in any number of ways with various heights. Besides, the cost of this pallet rack system is the least expensive and it can be paired with any type of lift truck.

There are the reasons for select single-deep pallet rack. Firstly, it can help Garmin company to maximize their profit because the low cost to install the single-deep pallet racking. The convenient to use any type of lift truck will help company to avoid extra cost for buying suitable lift truck. The volume of Garmin car navigation product be produced basically is medium amount. According to Wikipedia, Garmin also produce many other type of product beside car navigation product. Hence, single-deep pallet racking is good for Garmin to store their product because it can utilize the space and store the product that wait for shipping purpose. The weights of Garmin products were not very heavy because the product is small electronic product such as car navigation, fitness device, mobile phones and so on. All the Garmin product will be pack in the box like a cube with specific label to be store at single-deep pallet rack. As state by Murray, the major disadvantage of single-deep pallet rack is it require significant floor space for suitable aisles.

Radio frequency identification will be used in single-deep pallet rack to help operator to check and identify the product for retrieved and shipping. According to Wikipedia, there have few safety precautions need to be take care because of the size and weight of pallets. Any loose components in the pallet rack system need to be pay attention and report the damage to avoid the fall of pallets. Climb on racks during or after assembly should be avoid because it will cause serious injury and storage racks are not designed to be stepped or climbed on. Visible warning signs should be conducted in the environment. Company should use only quality pallets that are not damaged and never overload the recommended load specification in the racking system. Rack audit should be performed by a qualified inspector to ensure the safety standard

3.0 METHODOLOGY

By referring to the similar product, we have make assuming on the production and process of the Garmin GPS product. We get the information from the internet resource and our manufacturing system engineering text book- Automation, Production Systems, and Computer-Integrated Manufacturing third edition.

4.0 FINDINGS

From this research we have find out that will be almost the same process of the production to the Garmin navigation product. By with this research , we have learn how to carry out the normal research and procedure.

5.0 DISCUSSION

The Advantages of Having to Implement Manufacturing System in Production of the product.

Through the group discussion, we have identified some advantages for the implement manufacturing system in production of the Garmin product. We have found out some manufacturing systems have involve in the process of Garmin production. For example, surfaces mount technology, anisotropic conductive adhesive and injection molding process. Most of the processes in Garmin production involve the flexible manufacturing system.

Firstly, the advantage for implement manufacturing system in production of the Garmin product is minimizing the cost and maximizes the profit. In our opinion, the manufacturing system can help to reduce the labor cost, management, defect cost and shorter the production cost. This is because it can help the production become more efficiency and enable the demand of customer be achieve in time which will increase the profit of company.

Advantage of manufacturing system in production of Garmin product is reduced direct labor requirement and increase labor productivity which can be show in the flexible manufacturing system. The increase of production rates with lower labor required show greater productivity per labor hour. The higher the productivity, the quality of product needs to be control. Direct labor requirement will be reduce due to the automated process systems. Through the help of automated assembly process, the rate of quality error and defect cost can be reduce. Surface mount technology is a good example for flexible manufacturing system which will bring much benefit to the production process.

Besides, it can also lower the product manufacturing lead time. The work-in-process of the production can be reducing due to help of flexible manufacturing system. The reductions of production time mean the faster customer deliveries. Furthermore, each workstation of assembly process which implements manufacturing system basically will be carried out automatically with the setting of computer. So, the process of production still can be operating during the night time without worker attention. The space of the factory floor can be reduced due to the flexible manufacturing system. Fewer machines will be required in flexible manufacturing system because of higher machine utilization. Fewer machine only required less space in the factory.

Therefore, implementations of manufacturing system of production which is conduct in production of Garmin product have brought advantage but it still have disadvantage.

6.0 CONCLUSION

The manufacturing system engineering is becoming greater and important in manufacturing sector to smooth all the process of manufacturing and done the process in shorter time such as consideration of process in Flexible

manufacturing system or cellular manufacturing or group technology.

Here, we can understand the process of Garmin Car Navigation product can be made through the three important parts. It is send to the assembly line to combine and fitting all together. Some part of the machine is involve automated system such as PCB and casing injection molding, whereas the LCD is involve manual or automated system depend on situation. We have examined and assume the assembly line, transfer line and product storage.

In addition, the method that we conduct in this research is by assuming process. We refer the other similar product such as mobile phone manufacturing process. The limitation in this research is we cannot go to the Garmin navigation product manufacturing factory to see the whole production process and get the real and true information.

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