Design and Modelling of Automated Shed for Vehicle Protection and Space Utilisation

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Abstract-*The proliferation in the number of vehicles has led to increase in parking problems. This is due to the fact that the current transportation infrastructure and car park facility developed are unable to cope with the influx of vehicles. This problem persists in the residential areas as well. The proposed project thus aims at the design and fabrication of an automated shed that makes proper utilisation of space and provides protection to the vehicle. The shed is electrically powered and consists of components like motor, actuator, fibre sheet and RFID reader, RFID writer, RFID barcode scanner. Programming is done by using Arduino Software, which supports timely movements of the shed i.e. folding and unfolding with car movement which is detected by unique feature of RFID Technology. 3D modelling and its Stress analysis of the prototype is done using Creo Parametric 2.0 and ANSYS Workbench 16 respectively.*

Keywords-RFID, spur gear, modelling, etc.

I. INTRODUCTION

In the year 2006, according to a survey 458,293 new registered vehicles were reported compared to the year 1999 where there were only 296,716 new registered vehicles, which makes it a rough estimate of 54.5% increase in a span of 7 years (Malaysian Ministry of Transportation, 2007).Whereas in 2000, a report estimated that there were 600,000,000 cars in the world and by 2030 that number could double to 1.2 billion. Referring to the aforesaid statistics provided by the Malaysian Ministry of Transportation, the current transportation infrastructure and car park facilities are deemed insufficient in sustaining the influx of vehicles on the road. Therefore, problems such as traffic congestion and insufficient parking space inevitably crops up. It indicates that the biggest problem that the auto industry would contend with is parking.

There have been a few improvements on the parking experiences to keep up with the growth of vehicle ownership. Converting a lot of open space into parking was the first improvement, and then building large buildings, also known as parking garages are the second. Since then, little has been done to find a new solution. Those two systems have remained, until the invention of the automated parking system.

This problem persists in the residential areas as well. In residential complexes due to unavailability of vacant parking space in the closed parking area, residents are forced to park their vehicles in the open parking area along the inner side of the compound walls of the society. In such cases, the vehicles do not have any protection. Thus, their safety is compromised with. Permanent sheds can't be made in the open parking area as it will consume a lot of space permanently. Thus we need a system that makes proper utilisation of space and provides protection to the vehicle. Thus the need of automated shed that will allow us to utilise that space for other purposes when the vehicle is not parked there arises.

1.1. Problem Statement

The main issue to be tackled is to design and manufacture a prototype of an automated shed which will protect the cars parked in the open parking area of a society with proper utilisation of space. Thus the problem statement for the project is 'To achieve protection of vehicles with proper space utilization by designing and fabrication of an automated shed'.

II. LITERATURE SURVEY

Oluwaseyi1 0. et.al (2014) in their paper stated that parking and traffic congestion is synonymous to each other because failure to meet parking demand of people in a city lead to on-street parking that results to traffic congestion. Traffic congestion is a condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing. The availability of less space in urban areas has increased demand for parking space especially in central business area. Insufficient off - street parking facilities results in on-street parking which reduces the effective width of roads, thus leading to obstruction of traffic flow. This type of parking space is not located on road side, in which any member of the public can park. It should be constructed with the mandate of specific regulations (e.g. maximum stay hours or minutes, payment of fee, etc.) and can be operated by public or private sector or organization. It promises to provide accessibility for people to visit downtown or any places within the city because the people are confidence of where to park.

Zhan G. (2013) proposed that paper investigates the effect of home parking convenience on households' car usage, and the implications to residential parking policies. This paper aims to examine the effect on household car usage given the same car ownership level—basically whether different types of home parking 'make' some households use cars more than others even though they have the same number of cars. Because most house- holds do not pay for home parking at a per usage base, A new concept of "parking convenience" is developed.

Faheem et.al (2013) concluded that the industrialization of the world, increase in population, slow paced city development and mismanagement of the available parking space has resulted in parking related problems. There is a dire need for a secure, intelligent, efficient and reliable system which can be used for searching the unoccupied parking facility, guidance towards the parking facility, negotiation of the parking fee, along with the proper management of the parking facility. Intelligent Parking Service is a part of Intelligent Transportation Systems (ITS). This paper reviews different Intelligent Parking Services used for parking guidance, parking facility management and gives an insight into the economic analysis of such projects. The discussed systems will be able to reduce the problems which are arising due to unavailability of a reliable, efficient and modern parking system, while the economic analysis technique will help in analysing the projects' feasibility. The Intelligent Parking service, a part of Intelligent Transportation System (ITS), gives rise to different parking facilities on the basis of new functions they provide. This service not only manages the internal operations of the parking facility, but it is also designed to work with different aspects related to the parking facility.

Reve S. V. et.al (2012) proposed a Parking (MCPS/WSN) Management System based on wireless sensor network technology which provides advanced features like remote parking monitoring, automated guidance. It describes the overall system architecture of MCPS from hardware to software implementation in the view point of sensor networks. Here we have proposed a software implementation using wireless sensor network for management of car parking system without entering into the parking lot. Parking status can be known by the driver at the entrance of the parking lot only.

Subramani T. (2012) in his paper stated that parking is an essential component of the transportation system. Vehicles must park at every destination. A typical automobile is parked 23 hours each day, and uses several parking spaces each week. Parking facilities are a major cost to society and parking conflicts are among the most common problems facing designers, operator, p[lanners and other officials. Such problem can be often defined either in terms of supply (too few spaces are available, somebody must build more) or in terms of management (available facilities are used inefficiently and should be better managed). Management solutions tend to be better than expanding supply because they support more strategic planning.

Srivastava M. K. et.al (2015) have studied problem encountered regarding parking lot management that is by the help of RFID TECHNOLOGY. RFID System is used to help parking of car automatically in the parking lot. RFID System uses RFID Tags, Reader makes it easier for in and out of parking subscribers. Personal cost will be reduced using the technology. It will be possible in future to make unnamed, secure and atomized parking-lots functioning with RFID technology. Check-in and check-out of car will be handled in a much faster manner as driver will show his RFID Tag car to reader through which automatically balance will be deducted from card and car will be made to get in the parking lot. This helps in increasing security and ticket jamming problem that occur at parking area when a person used to park car in parking area. The system model proposed is successfully created and tested. In this a car with tag is permitted to enter the parking lot else a car with no tag or invalid is made to be restricted for the entry in the parking lot. The process of accessing the vehicle ID will take time in microseconds. Hence this is a less time consuming technique. The proposed system results a reliable parking solution in big cities where less space available for parking. This system replaced the conventional parking along the sides of streets with a multi-storey parking solution. Hence the problems like traffic jam, less security etc. during parking are minimized.

Soni E. et.al (2014) in their paper suggested a solution for the problems encountered in parking-lot management systems via RFID technology. The application of RFID technology in parking lots makes parking effective, convenient and safe. The RFID system is used to park the cars automatically in the multilevel parking area. The use of RFID tags, readers and antennas makes it easier to automate the 'in and out' privileges of parking subscribers. Personnel costs will be reduced considerably using this technology. It will be possible in the future to make unmanned, secure and atomized parking-lots functioning with RFID technology. The proposed system has been designed and tested under the environment conditions and optimum results have been achieved. The proposed system works appropriately for all the purposes for which it is designed. The process of accessing the vehicle ID will take time in microseconds. Hence this is a less time consuming technique. The proposed system results a reliable

parking solution in big cities where less space available for parking. Future research work would be the extension of this system by calculating the duration of stay of a vehicle in a parking lot as well as deduction of the parking charges on the basis of time spent. The tag will be recharged with a certain amount and this amount will be deducted at each visit. For realization of this a time recording technique is to be used. By using this kind of system the manual work will be minimize at a great extent.

Harikrishnan R (2015) has explained the working of arduino software programming and he states that Context aware or event based system requires location information of the event of occurrence. Sensor positioning and its location information are mandatory if a data sensed by the wireless sensor network (WSN) has to be meaningful. In cases like routing of packets of data in WSN, the dead sensor nodes should be avoided in the route. For this the location of live nodes is needed, so that the shortest and reliable routing is possible. Moreover some data require inherent location detection like forest fire detection or movement of miners in mines. So localization with better performance, with more reliability, with less computation complexity and lesser cost is much needed. This paper shows an integrated XbeeArduino and differential evolution approach for localization in wireless sensor networks, and the design of differential evolution localization algorithm for minimization of localization error. The algorithm is simple to implement and uses less control variables

Akira Todoroki et.al (2015) have studied about Impact damage detection of a carbon-fibre-reinforced-polymer plate employing self-sensing time-domain reflectometry and he states that A non-destructive inspection method of carbon fibre reinforced polymer (CFRP) is self-sensing technology that uses carbon fibres as sensors. The technology applies electric current to composites and measures the electrical resistance change to detect damage. Although the technique detects damage precisely, it requires many electrodes on the CFRP surface. Time-domain reflectometry (TDR) has previously been proposed to detect damage over a wide area with a small number of electrodes and applied to detect fibre breakage in unidirectional CFRP ply specimens. In the present paper, experiments are conducted for a cross-ply CFRP laminate subjected to impact damage. Three impact loads are applied and the damage is inspected employing self-sensing TDR and a micro-strip line. Results show that the self-sensing TDR can be applied to laminated CFRP structures that have several fibre directions and when damage such as a delamination crack extends under or close to the micro-strip line. In the present study, impact damage was applied to toughened CFRP laminates. Three impact loads were applied and the damage was inspected employing the self-sensing TDR method and an MSL. The first impact was under the MSL line. The second and third impacts were to locations away from MSL with different impact energies. Both the second and third impact loads generated delamination cracks and broke fibres. The damage created with lower impact energy, however, did not reach the MSL, whereas the damage created with higher impact energy included a delamination crack under the MSL. The results obtained reveal the abilities and limitations of the self-sensing TDR technique as follows.

1) The self-sensing TDR can be applied to a laminated CFRP that has several fibre directions. Only the fibre direction of the surface ply is important for toughened CFRP laminate.
2) Damage such as a delamination crack under or close to theMSL can be detected according to the reflected signal employing self-sensing TDR.
3) Damage away from the MSL cannot be detected by self-sensing TDR.

Wahba M. et.al (2015) studied about thermal degradation mechanism of polycarbonate Nano composites, according to them Argon-rich shielding gas was replaced by 100% CO2gas for cost reduction in fiber laser-GMA hybrid welding of double-side welded T-joints. The welding process using 100% CO2gas was characterized by a large number of spatters, while the penetration depth of a weld was increased and porosity was reduced. With the objective of obtaining a buried-arc transfer for the reduction of spatter formation, the welding parameters were optimized by observation with a high-speed video camera. Reduced arc voltage, arc leading arrangement and shortened wire extension were necessary to achieve a buried-arc transfer. A significant reduction in spatter generation could only be obtained by the procedure that the relative distances between the two heat sources in the X and Y directions were controlled to produce a proper profile of the arc cavity that could trap any spatters generated. A regulating action of a keyhole was observed to remove the disturbances in the melt flows caused by the arc short-circuiting, and high quality joints with good appearances and very few spatters could be produced.

Xiao J, et.al (2013) stated in Effect of organically modified montmorillonite on thermal degradation Mechanism of polycarbonate Nano composites that by studying previous reported papers, there were contradictory results about the effect of clay on thermal stability of polycarbonate (PC). For ascertainment of the actual role of clay, PC Nano composites were prepared by direct melt-mixing PC with hexadecyltrimethyl Ammonium chloride modified montmorillonite (OMT). The results of XRD, TEM and HREM experiments present the formation of uniformly

intercalated structure. TGA shows the onset decomposition temperature of PC/OMT nano composites is earlier 65 °C than pure PC. The mechanism of PC thermal decomposition effected by OMT was discussed in detail. It reveals that OMT can catalyze thermal degradation of PC chains and decrease thermal stability of the nano composites.

III. PROPOSED MODEL OF AUTOMATED CAR PARKING SHED AND IT' S COMPONENTS

3.1 Creo Model

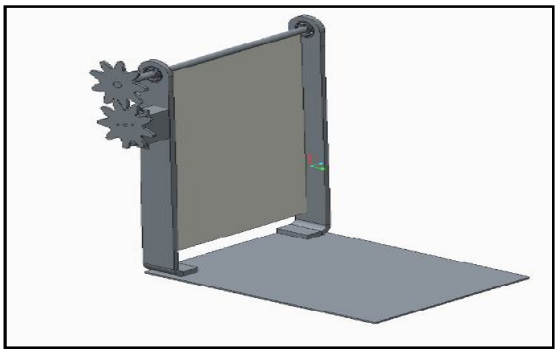

Fig.1. Isometric View

3.2 RFID

RFID is a generic term for technologies that use radio waves to automatically identify individual items. There are several methods of identifying objects using RFID, but the most common one is to store a serial number that identifies a product and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called an RFID transponder or an RFID tag). The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves returned from the RFID tag into a form that can then be passed on to computers that can make use of it.

3.3 RFID Reader

The reader communicates with the RFID tag via radio waves and passes the information in digital form to a computer system. The underlying principle is inductive coupling. The coiled antenna of the reader creates a magnetic field with the coiled antenna of the tag. The tag draws energy from this field and uses it to send back waves to the reader, which is turned into digital information, such as the tag's Electronic Product Code.

3.4 RFID Tags

Three main types of RFID tags are available currently in the market. They are namely active, passive and semi-passive tags. Active tags which have both an on-tag power source and an active transmitter offer super performance. Because they are connected to their own battery, they can be read at a much higher range (upto several meters). But the drawback of this kind of active tags is that they are very expensive. Passive tags have no power source and no on-tag transmitter [1, 2]. The range of these tags varies from few meters depending on the frequency of operation. They are sensitive to regulatory and environmental constraints. Passive tags are powered by the magnetic field generated by the reader.

Semi-passive tag is a hybrid of both active and passive tags. It has a smaller battery that is partially recharged each time the tag enters into the electromagnetic field of the reader. These tags are currently under commercial development.

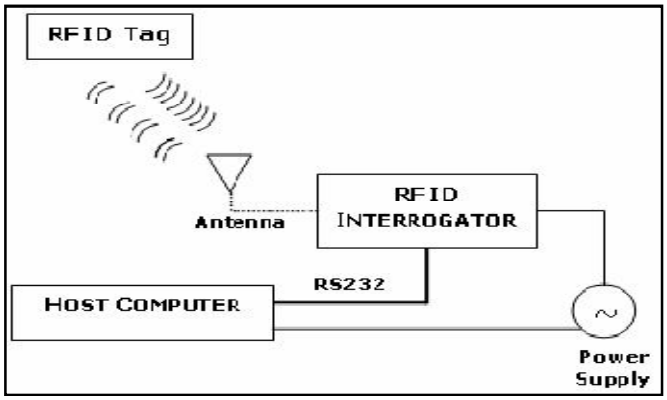

Fig.2. RFID Circuit Diagram

3.5 Polycarbonate Sheets

Polycarbonates received their name because they are polymers containing carbonate groups (–O–(C=O)–O–). A balance of useful features including temperature resistance, impact resistance and optical properties position polycarbonates between commodity plastics and engineering plastics. Polycarbonates (PC) are a group of thermoplastic polymers containing carbonate groups in their chemical structures. Polycarbonates used in engineering are strong, tough materials, and some grades are optically transparent. They are easily worked, molded, and thermoformed. Because of the properties, polycarbonates find many applications. Polycarbonates do not have a unique Resin identification code (RIC) and are identified as "Other", 7 on the RIC. Products made from polycarbonate can contain the precursor monomer bisphenol A (BPA).

Polycarbonate is a durable material. Although it has high impact-resistance, it has low scratch-resistance and a hard coating is applied to polycarbonate eyewear lenses and

polycarbonate exterior automotive components. The characteristics of polycarbonate compare to those of poly methyl methacrylate (PMMA, acrylic), but polycarbonate is stronger and will hold up longer to extreme temperature. Polycarbonate is highly transparent to visible light, with better light transmission than many kinds of glass.

IV. CONCLUSION

Parking is becoming an expensive resource in almost any major city in the world. The project has the potential to provide smart utilization of space for parking as well as for any other applications and thus can be widely implemented in residential societies for protection of the vehicle from damages caused by environmental factors while they are parked in the open parking areas of the societies. The use of the proposed automated shed can effectively overcome this problem. The automated shed can be used in open parking areas in residential societies instead of compromising with vehicle's safety. The automated shed can also be used for parking logistic vehicles which bring raw materials to the industries which are traditionally parked in the open space. Hence the equipment promises to offer great commercial and domestic advantage.

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