iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 Issue: III Month of publication: March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3027

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

Technology for Agriculture to increase food Production and Quality: A review

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Abstract: Agriculture is a food producing industry. Most of the rural households depends on agriculture for their survival. For increasing population requires the food production to be increased with good quality. The Growth, development and stability of the Indian economy is highly depends on the agriculture. There is variety of task to be performed to produce a food in agriculture. This paper presented an overview of worldwide development and present status of automation and robotics technologies used in precision agriculture application.

Keywords: Robotic Technology, Artificial intelligence, Machine vision system, Mechatronic system, Agriculture.

I. INTRODUCTION

India is a nation of agriculture. Earning source of most of the Indian population is depends on agriculture. The Growth, development and stability of the Indian economy is highly depends on the agriculture sector. It is one of the most important food producing industry for survival of Indian population. There are various processes has to be carried out for producing the food in agriculture. Traditionally agricultural industry fully dependent on human labor and limited application of agricultural machineries and mechanical equipment. Due to decreasing labor force and insufficient skill so there is a need of automation in agriculture applications so advanced technology such as Unmanned Aerial vehicle, flying drown Mechatronic system, embedded computing, wireless technology, sensors, controllers, GPS/GIS (Geographical Positioning System/Geographical Information System) and DBMS (Database Management System) software and different algorithms are seen to be recent development.

Agriculture comes from two Latin words:

1) ager which means a field or farms.
2) culturia which means land or soil cultivation.

A Robot is a multifunctional manipulator design to move and performed certain tasks by programmed and reprogrammed with mobile body or a stationary platform.

II. APPLICATION OF ROBOT IN AGRICULTURAL TASK.

Continuous development in technology results we have powerful hardware devices and dedicated software packages that implement in performing variety of agriculture task. Robots are used land cultivation and treatment, seed sowing, plant cutting and monitoring, vegetable and fruit picking in green house and field application. Others applications like milking of cows, shearing sheep and many more.

III. MODERN TECHNOLOGY USED IN MOBILE ROBOT

(Rubens Andre Tabile, Eduardo Paciencia Godoy, Giovana Tripoloni Tangerino, Arthur José Vieira Porto, Ricardo Yassushi. Inamasu, Rafael Vieira de Sousa et al., 2013) [1] Proposed development in electromechanical component and implementation of a modular robotic platform for data acquisition and research of new advanced technologies for remote sensing in agricultural environments. The robotic platform has a multifunctional characteristic that allow the coupling of modules for infield data acquisition by means of sensors and portable equipment. The data will be used in the study of spatial variability. To enhance the remote sensing activities in agricultural environment.

(I.H. Celen, E. Onler E. Kilic et al., 2015) [2] Presented an ultrasonic distance measuring based row guidance method is used to guide a robot platform which is to move through the crops row in a field. The robot platform are detected real-time for guiding the robot inside the crop row and also turn at the end of the rows to adjacent row automatically. Robot tested in rose field with algorithms of row guidance and headland turn are according to the parameters measured and analyzed such as the offset for row guidance and the difference between the motion trajectory of the robot and the expected trajectory with good accuracy of row guidance.

(Stephanie Bonadies Neal Smith Nathan Niewoehner Andrew S. Lee Alan M. Lefcourt S. Andrew Gadsden et al., 2018) [3] Proposed work to developed crop row navigational software to allow the ground-based robot to autonomously navigate a crop row setting. A proportional–integral–derivative (PID) controller and a fuzzy logic controller to compare the efficiency of each controller based on which controller navigated the crop row more reliably.

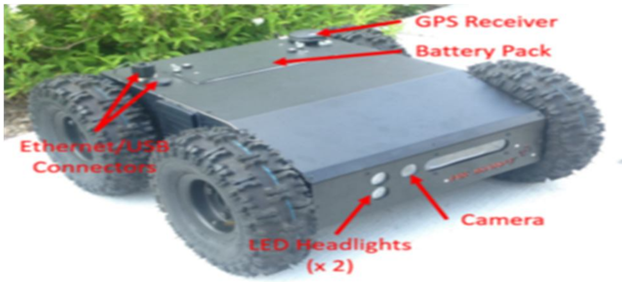

Fig. 1 Jaguar 4x4 platform configuration

H.G. Tanner, K.J. Kyriakopoulos, N.I. Krikelis et al., 2001) [4] Proposed design a prototype mobile manipulator for agricultural applications. The main components of the motion control system, including sensors and in-wheel motors, is described and derived the kinematic and dynamic models of the robot, with the aim to support the design of a trajectory tracking system and to make a preliminary assessment of the design choices, as well. (Luca Bascetta, Marco Baur and Giambattista Gruosso et al., 2017) [5] Developed the FroboMind software platform and performance evaluation in agriculture tasks. (Kjeld Jensen;, Morten Larsen, Søren H. Nielsen, Leon B. Larsen, Kent S. Olsen and Rasmus N. Jørgensen et al.,2014) [6] In this system automatic positioning systems of agricultural robots used in field works. Solution, which is easy to implement and is characterized by high accuracy positioning. And to develop manual and automatic motion control algorithms. M V Momot, A V Proskokov, A S Natalchenko, A S Biktimirov et al., 2016) [7] In this a modular design concept is employed in system development. The main aim is to maximize the flexibility, functionality and inter-changeability of the mobile platform and make one robot platform use variety of agricultural task. A prototyping system has been built to test the navigation and control methodologies in a controlled environment. The data recorded match with the simulation data. Then the prototype was taken to open field tests. The system performed and the mapping and re-tracking matched with the accuracy of the GPS system (Samuel J.O. Corpe and Liqiong Tang Phillip Abplanalp et al .,2013) [8] Proposed a fuzzy-logic based (FLB) approach is for real-time autonomous path planning of the robot in unstructured Environment. Simulation and experimental evaluations shows that FLB approach is able to cope with different dynamic and unforeseen situations by tuning a safety margin. Comparison of FLB results with vector field histogram (VFH) and preference-based fuzzy (PBF) approaches, reveals that FLB approach produces shorter and smoother paths toward the goal in almost all of the test cases examined. Then, a novel human-inspired method (HIM) is introduced. Comparison of HIM results with FLB suggests that HIM is more efficient and effective than FLB. (Seyede Fatemeh Heidari K et al., 2014) [9] Proposed Vision based autonomous driving of a four-wheel-drive platform for agricultural applications. The developed driving platform can be autonomously driven on any path pattern. The key contributions to development of unique navigation pattern to train the mobile robot to follow any kind of path pattern. (Min Hyuc Ko, Kyoung Chul Kim, Beom Sahng Ryuh, Abhijit Suprem and Nitaigour P Mahalik et al.,2013) [10] The problem of using navigation methods has been solved using deliberative and pseudo-reactive techniques. (Ehsan Kamran, Asadullah Mirasi, Mousarreza samadi et al., 2014) [11] To solved instability problem for a four-wheel independent driving mobile robot turning in the greenhouse. In order to improve the steering performance each wheel torque of the robot can be separately controlled, the dynamic model of the four-wheel independent steering system is firstly established by using the D'alembert's Principle and choosing the sideslip angle and the yaw velocity as the state variables approaching rate is proposed by adopting the sideslip angle and the yaw velocity as the joint control variables in order to make the sideslip angle be in the stable range and make the yaw velocity track the desired value well.

Fig. 3 Greenhouse turning tests of mobile robot

(Guoqin Gao, Qiuyue Qin, Sheng Chen et al, .2013) [12] A sliding mode control was applied to control motion of the robot in light of its kinematic model. Vision based algorithms were developed for navigation and operations of row planting crops. Vertical projection method was applied to calculate a guidance line for navigation. Preliminary tests were conducted to assess both guidance and operations.

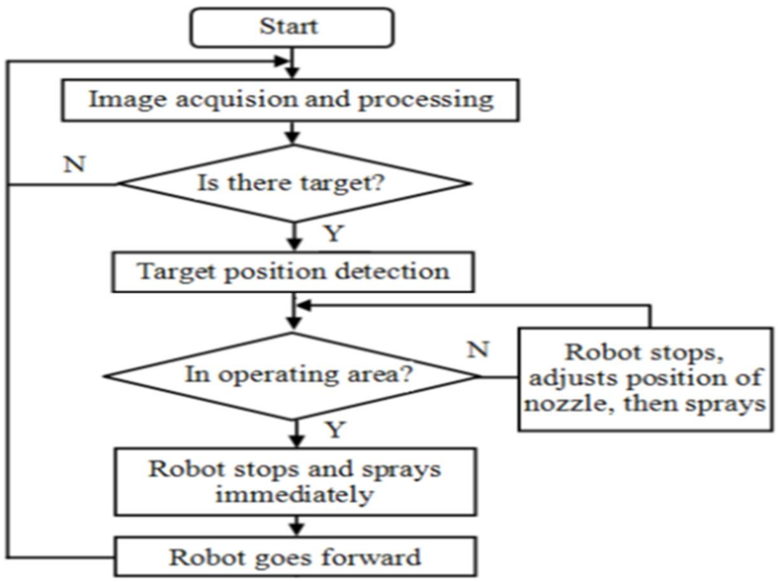

Fig. 4 Control algorithm of spraying operation

(Jin-lin XUE, Bo-wen FAN, Xin-xin ZHANG and Yong FENG et al., 2017) [13] Developed an approach for coverage planning for agricultural operations involving the presence of obstacle areas within the field area. A complete field area coverage plan that is executable by the navigation system of an agricultural field robot. The developed approach deal with any complex field and its obstacles. (Ibrahim A. Hameed, Dionysis Bochtis and Claus A. Sørensen et al., 2013) [14] Presented vision-based row guidance method to guide a robot platform which is designed independently to drive through the row crops in a field according to the design concept of open architecture. Then, the offset and heading angle of the robot platform are detected in real time to guide the platform on the basis of recognition of a crop row using Machine vision. (XUE Jinlin, XU Liming et al., 2010) [15] In this application of virtual reality in a robot navigational experiment using SolidWorks and simulated into MATLAB. Trajectories were initiated using Probabilistic Roadmap and compared based on travel time. The simulation results showed that the proposed method was able to conduct the navigational experiment inside the virtual environment. U-turn trajectory selected for crop inspection. (M. Saiful Azimi, Z. A. Shukri and M. ZaharuddinVirtual et al., 2017) [16] Presented an algorithm is for disease identification. Crops diseases can be identified by crop pictures, and the extent of the damage is calculated according to the injured area. Crop line is identified by the improved Hough transform algorithm. (Zhi-Hua DIAO1, Chun-Ying DIAO2, Yuan-Yuan WU3 et al., 2017) [17] The proposed navigation strategy is based on fuzzy-logic control different behavior blocks are suggested each behavior block is composed of sets of fuzzy-logic rule statements designed for achieving appropriate values for control parameters. The motion control variables of the mobile robot are the translational speed of the robot and the change in the heading angle of the robot. These navigation blocks are composed of fuzzy rules and statements. Inputs for the navigation blocks are sensor reading information. (F. Heidari, R. Fotouhi, M. Vakil et al.,2012) [18] He proposed machine vision system used in the weeding process robot can work in any field without requiring absolute coordinates of a path to be followed. GPS system combined with other sensors. Machine vision is preferred over ultrasonic or optical sensors, because of the ability to look forward which contributes to a more accurate control of the position of the weeding robot relative to the crop row. Though dead reckoning could contribute to the navigation accuracy. (Tijmen Bakker a, Kees Asselt van a, Jan Bontsema b, Joachim Muller c, Gerrit Straten van et al.,2010) [19] To developed robot for harvesting of apple with Machine vision system. Fruit recognition algorithm developed to detect and locate the apple on the trees automatically. The control system, including industrial computer and AC servo driver, conducted the manipulator and the end-effector picked the apples from tree. (Zhao De-An, Lv Jidong, Ji Wei, Zhang Ying, Chen Yu et al., 2011) [20] The robot designed to operate in a fixed position in the greenhouse. It was interfaced to a standard belt-conveyor displacement system that provides the robot with pallets containing the crops usually grown in pots. (G. Belforte R. Deboli et al., 2006) [21] Proposed strategy is composed of four main actions which are sensor data analysis, obstacle detection, obstacle avoidance and of agricultural applications, several vision-based crop and weed detection approaches for specific plants have been proposed. To develop static sensor array, several innovative solutions for field operation. Using these actions the navigation approach is capable of autonomous row-detection, row-following and path planning motion in farms. In order to drive the robot in off-road terrain, it must detect holes or ground depressions (negative obstacles) that are inherent parts of these environments, in real-time at a safe distance from the robot. (F. Heidari R. Fotouhi et al., 2014) [22] Developed method hierarchical decision making and trajectory planning method is studied for a group of agricultural robots cooperatively conducting certain farming task such as citrus harvesting. Within the algorithm framework, there are two main parts (cooperative level and individual level): (1) in the cooperative level, once a discrete reconfiguration event is Confirmed and re planning is triggered, all the possible formation configurations and associated robot locations for specific farming tasks will be evaluated and ranked according to the feasibility condition and the cooperative level performance index and (2) In the individual level, a local pursuit (LP) strategy based cooperative trajectory planning algorithm is designed to generate local optimal cooperative trajectories for agricultural robots to achieve and maintain their desired operation formation in a decentralized manner. (Ni Li Charles Remeikas Yunjun Xu1Suhada Jayasuriya Reza Ehsani et al., 2015) [23] In this a vision-based classification system for mobile robots to separate value crops from weeds. Sugar beets, an important crop in Germany and other countries in Northern Europe. Proposed system executes several steps. (P. Lottes M. Hoeferlin S. Sander M. M¨uter P. Schulze Lammers C. Stachniss et al., 2016) [24] to developed control system for efficient autonomous navigation in cross-country environments. Introduce new algorithms for obstacle detection and terrain cover classification. The problem of obstacle detection and avoidance is well studied in robotics, however, existing algorithms apply mostly to urban or indoor environments and don't work well in off-road conditions. (R. Manduchi A., Castano, A. Talukder and L. Matthies et al., 2005) [25] To develop a low cost localization system for a vineyard spraying robot. Development of the robot's kinematic and dynamic model controller design for path following, a visual odometry (VO) simulation and experimental results in a vineyard, navigation sensors and a novel multisensory data fusion algorithm for localization, along with simulation results. (Guy Zaidner, Amir Shapiro et al., 2016) [26] A vision-based row guidance method is presented to guide a robot platform which is designed independently to drive through the row crops in a field according to the design concept of open architecture. Then, the offset and heading angle of the robot platform are detected in real time to guide the platform on the basis of recognition of a crop row using Machine vision. And the control scheme of the platform is proposed to carry out row guidance. (XUE Jinlin, XU Liming et al., 2017) [27] This paper proposes the design of intelligent WiFi wireless controlled robots. For monitoring the microcontroller core, a wireless router for the network connection point is employed. The camera and android phones and smart monitoring system used to monitoring the operation. (Peng Jian-sheng et al., 2014) [28] To developed of two basic motion control algorithms, namely a GOTO algorithm and a FOLLOW algorithm, for use in a master–slave multi-robot system in farm operations. The GOTO algorithm can be applied when the master wants the slave to go to a specific place, a certain distance from the current operational position. In this GOTO algorithm, the slave was set to slow-down to allow the master pass the slave safely in case there was a potential collision due to path overlap in the field. (Noboru Noguchi, Jeff Will, John Reid, Qin Zhang et al., 2004) [29] He proposed at night the de-noising problem of night vision. The images is studied for apple harvesting robots. To applied wavelet threshold method to the de-noising of night vision images. Due to the fact that the choice of wavelet threshold function restricts the effect of the wavelet threshold method, the fuzzy theory is introduced to construct the fuzzy threshold function. Then he propose the de-noising algorithm based on the wavelet fuzzy threshold. Results to reduce image noise interferences, which is conducive to further image segmentation and recognition.

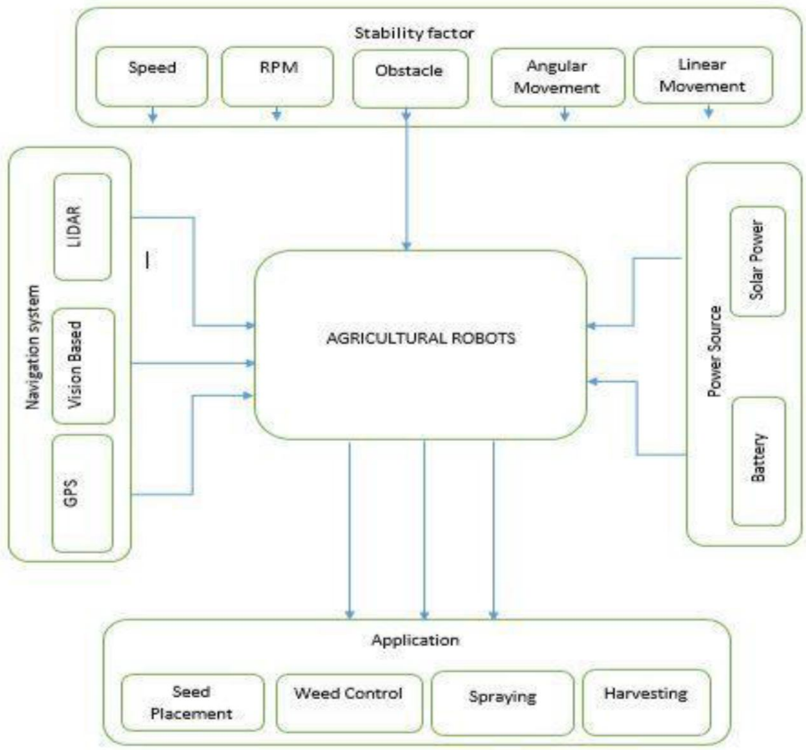

Fig.5 Architecture of Agricultural Robots

III. CONCLUSION

This paper proposed Robotic technology used in agriculture application. Traditional manual pesticide spraying operation is full of direct exposure to the pesticide liquid work environment, most of farmers lost their life and health related problem have been recorded in resent year. So this system can be used in pesticide spraying operation the jobs in agriculture are a drag, dangerous, require intelligence and quick, though highly repetitive decisions hence robots can be rightly substituted with human operator.

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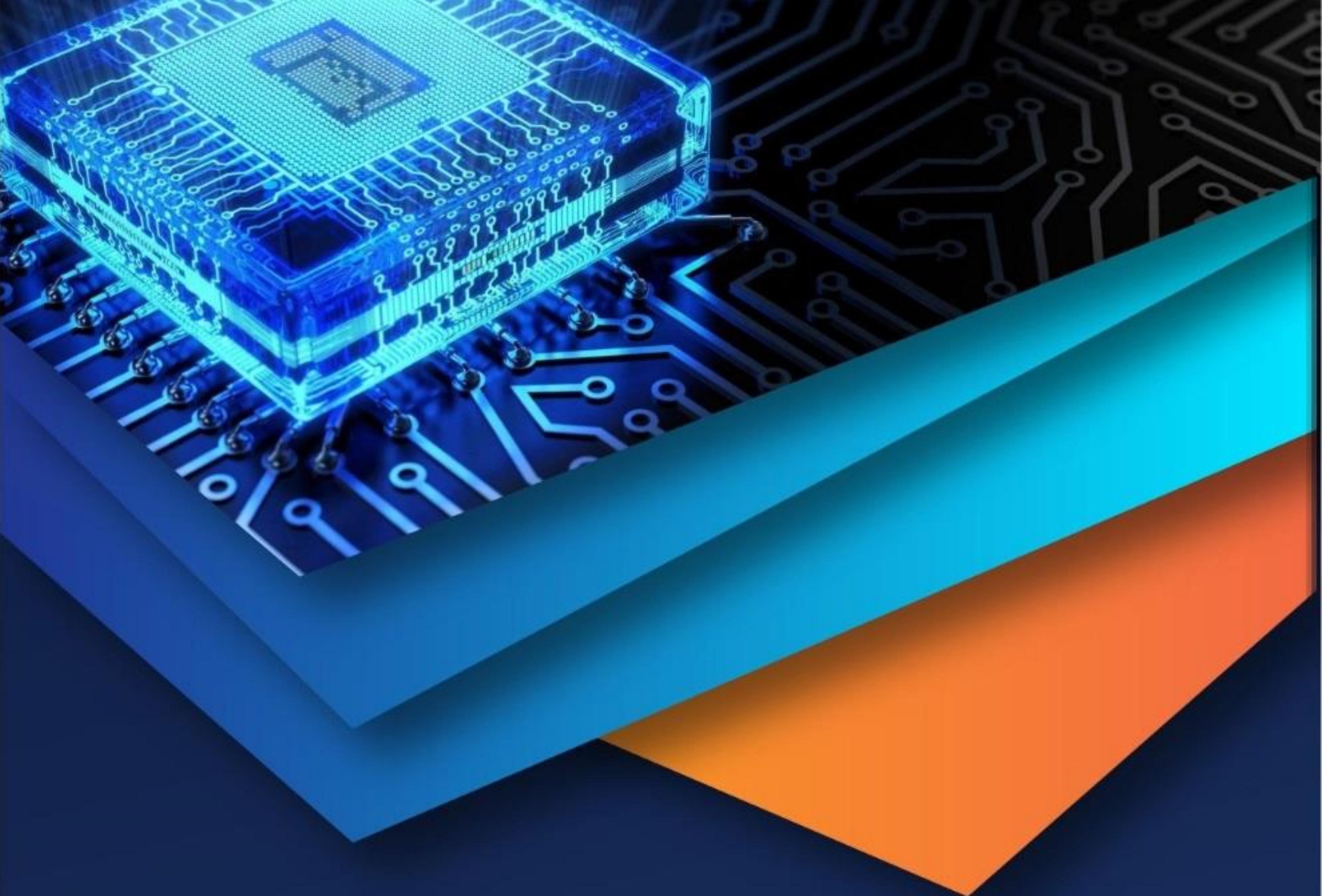

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