[Sushma* *et al.*, 5.(5): May, 2016] ISSN: 2277-9655
IC™ Value: 3.00 Impact Factor: 3.785

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

DESIGNING CST IMPLEMENTED COGNITIVE ARCHITECTURE [CSIA] FOR THE AGRICULTURAL FRUIT PICKING ROBOT

Sushma.D.S*, Ashwini.K, Govindaraju, Dr. M .V. Vijayakumar
* Department of Information Science and Engineering,New Horizon College of Engineering,Bengaluru-560103
Assistant Professor, Department of Information Science and Engineering, New Horizon College of Engineering,Bengaluru-560103
Assistant Professor, Department of Information Science and Engineering, BTLIT,Bengaluru-560099
Professor and PG Coordinator, RPRC member s, Department of Computer Science & Engineering, Dr.Ambedkar Institute of Technology, Bengaluru-

DOI: 10.5281/zenodo.51903

ABSTRACT
There is a great need for mechanisation in the agriculture field. The development of Robotics technology is growing very rapidly. This paper focuses mainly on fruit-picking robots. The different kinds of fruit-picking robots that exist currently, their disadvantages are discussed in this paper. This paper discuses the proposed solution to overcome one of the disadvantages of existing fruit-picking robots.

KEYWORDS: Cognitive architecture, CST [Constructing Skill Trees] , Sensorimotor Skills.

INTRODUCTION
Agriculture is the humankind's ancient occupation. Though we have moved forward, still agriculture remains one of the most important economic activity of the mankind. There are several issues in agriculture such as irrigation, soil erosion, agricultural marketing, inadequate water supply, lack of mechanisation. Due to lack of mechanisation, the agricultural production activities are completely dependent on human work. Human beings cannot work 24/7 in all climatic conditions at all times. So the application of mechanisation in agriculture helps in reducing the human efforts and increasing the agricultural productional yield rapidly. Robots are getting more advanced day by day. But many of them have problem in handling delicate tasks. The robots also face a problem in adapting to changing conditions. In agriculture, the opportunities for robot-enhanced productivity are immense and the robots are appearing on farms in various forms and in increasing numbers. We can expect the robots performing agricultural operations autonomously such as spraying and mechanical weed control, fruit picking, watching the farms day and night for an effective report, allowing farmers to reduce the environmental impact, increase precision and efficiency, and manage individual plants in novel ways.

The present project is one among those, which involves improvement in the fruit picking robot. The fruit picking robots need to pick ripe fruit without damaging the branches or leaves of the tree. Mobility is a priority, and the robots must be able to access all areas of the tree being harvested. It goes then without saying that the robots must be intelligent [1], and have a human-like interaction with their surroundings through senses of touch, sight, and image processing. One of the disadvantage of fruit picking robots is that they are not able to distinguish between the ripe fruit and unripe fruit. while picking. This motivated us to add human intelligence to the robots so that it can distinguish between the riped and unriped fruits.

PROBLEM DEFINITION

Due to lack of mechanisation in agriculture, we find various issues in agriculture. There is urgent need to mechanise the agricultural operations so that the wastage of labour force is avoided and farming is made more convenient and efficient. Robotics can play a significant role in the agricultural production. Robots like these have many benefits for the agricultural industry, including a higher quality of fresh produce, lower production costs, and a smaller need for manual labour. There are various kinds of robots used in different fields of agriculture like Robot for weed control, Forester robot, Robot in horticulture, Fruit picking robots, etc. The existing fruit-picking robots have many disadvantages. In this paper we have proposed a solution for overcoming one of the disadvantage of fruit-picking robot which is its inability to differentiate between ripened fruit and unripe fruit at all times.

EXISTING SYSTEM

The fruit-picking robots have several disadvantages. One of the disadvantages of driverless machines for agriculture is its liability. Robots could change the culture of agriculture. Energy issues are proven to be costly. Few disadvantages of fruit-picking robots are :

Fruits are covered by leaves and branches.

The robots have to pick the fruits without damaging the branches and leaves. Humans will apply their conceptual skills. More attention is given to the details of the shape of the fruit, colour of the fruit. But the robots will use their image processing technique to identify the fruits. They use airjet to blow out the leaves and then pick the fruits.

Pressure applied on fruits can crush the fruits

In some cases, the pressure applied on fruits while picking the fruits, can crush the fruits making the fruits no longer useful. Humans will make use of their critical thinking skills. They observe, interpret, analyse, infer and evaluate their decisions. According to their decision they will apply the required pressure and pick the fruits. This results in picking the fruits without damaging. The robotic arm is made of rubber to minimize the damage occurred while picking the fruit.

The fruit-picking robots cannot distinguish between ripe and unripe fruit

Humans use their decision making skills, knowledge of concepts that they have already learnt and decide whether a fruit is ripe or not. They compare the results of the previously picked fruits and hence they will correctly choose the ripened and unripe fruits. The robots will rely on their image processing abilities. A camera is mounted on top. It captures the size, colour, weight, shape of the fruit. This image of the fruit is compared with previous images of the fruits and is classified accordingly as ripe or unripe fruit.But this image processing might fail in certain abnormal conditions. The fruit might look ripe when compared with its colour, but actually the fruit is unripe. In such cases the robot will misinterpret this result and classify it as ripe fruit and picks it.

They cannot distinguish between the color of the leaves and colour of unripe fruits

Humans will have knowledge about the problem solving skills. They analyse and then differentiate between the fruit and other parts of the tree. The robot again has to rely on its image processing capability to identify the shape and density of the fruit. This will be compared with its previously captured images. Then it comes to a conclusion which may be corrector incorrect.

They pick the fruits by damaging leaves and branches

Humans think logically. They work creatively in order to pick fruits without damaging leaves , branches and other parts of the tree. In robots, the robotic arm is made of rubber. This will lessen the damage but will fail to prevent the damage from occurring.

All the above mentioned scenarios are some of the disadvantages of existing fruit-picking robots. We are focusing on the disadvantage that the inability to distinguish between ripened and unripe fruits during fruit-picking.

An agricultural robot must be equipped with intelligence so as to be able to robustly operate in the unstructured, dynamic and hostile agricultural environment.

The proposed solution is to develop a cognitive architecture[1] where the agents exhibit different levels of thinking. The prime focus is acquisition of sensorimotor skills. The robots have to discover their own body and acquisition of associated cognitive skills such as self and non-self distinction.

NEWLY PROPOSED ARCHITECTURE

Development of learning methods that allow robots to acquire models of the dynamics of their own bodies and interactions with new objects.

Challenges:

1.Learning is incremental process through physical interaction as it is impossible to anticipate all situations.
2. Data has to be acquired autonomously through sensorimotor requirements that are costly in time and energy.
3. How an agent discovers skills?[6]

Human intelligence and interactions consists of an important feature i.e., acquisition of new skills, ability to create new skills, refine them through practice and then apply in new task contexts.

To achieve this feature, Autonomous skill acquisition is incorporated in artificial intelligence. Achieving autonomous skill acquisition [6],we should design a robot system such that while solving a problem, we can identify a sub-problem that may be important in the future, capture them as skills and frame each skills as learning problem, use certain form of learning to improve each skill policy over time and finally when faced with new problem, use existing skills as necessary to find a solution to that problem. And hence it would be faster.

CST Implemented architecture is implemented as 5-layered architecture.[7]The layers of this architecture define incremental control systems for robots that show different levels of thinking. The five layers are reflexive, reactive, deliberative(including all BDI MODELS), [4] thinking and meta-thinking. The three columns are perception, intention, and reasoning.

EXPLANATION

Reflexive Layer

It is the first level where the agents exhibit the simplest behaviours.For a given input the agents will produce the output.The agents will act on the input (i.e.,perception).Behavioural response such as an action will be the output.The reflexive agents form the first layer of CST Implemented architecture. Reflexive agents are designed so that they follow the environment rules. The agents will sense the surroundings around them such as the presence of edges, center points, obstacles, etc. For each move, they will see their adjacent positions then make their next move. The reflexive level exhibits simple reflexes such as avoid hitting the wall, avoid obstacles. [5]The main task of such agents is to move in the environment and avoid collisions with other agents and objects in the environment.

Reactive Layer

In the reflexive level the output will always be the same for the same input .In reactive level the output is determined not only by its input , but also by its internal state. Reactive agents comprise the second layer of CST Implemented architecture. Reactive agents exhibit goal-oriented behaviour. [5] They add on to the behaviour of the reflexive agents.

Deliberative Layer

The goals that reactive agents attempt to satisfy are specified by the deliberative agents. Deliberative refers to any system whose output is not only determined by its input and current state, but also by it previous states and/or the current/previous states of other systems. Deliberate agents occupy the third layer of CST Implemented architecture. The BDI [3] agents determine which of the reactive or reflexive control mechanisms are active according to the goals the entire architecture attempts to satisfy. The deliberative agents effectively follow different goals based on cost and utility functions.

Thinking Layer

The agents will make decisions at one level, based on the actions that occurred at another level. Thinking makes use of reinforcement learning. This learning improves the effectiveness and efficiency of the architecture. The actions for agents are to be experimented by trial and error method.

Meta-thinking Layer

Meta-thinking refers to thinking on thinking .The learning ability of the agents in the thinking layer is improved over time. Actions that are learnt in thinking layer will be captured as sub-skills so that, they are used for future conditions. The agents in meta-thinking layer communicate with the other agents.

CONCLUSION

By using CST in the learning layer, the agricultural robots will be able to use the skills acquired in some problem to more quickly solve a new problem. This helps in faster skill acquisitions which helps us to distinguish between riped and unriped fruits. By CST we can overcome the disadvantage of existing fruit picking robots.

REFERENCES

[1] Singh, P., & Minsky, M. "An architecture for cognitive diversity. Visions of Mind, Darryl Davis (Ed.), London: Idea Group, Inc", 2005
[2] Hossein Miri,"CernoCAMAL: A probabilistic computational cognitive architecture.", 2012
[3] Wellman,H.W.,Cross,D.,&Watson,."Metaanalysis of theory-of-mind development,'The truth about false belief", 2001
[4] Georgeff, M., Pell, B., Pollack, M., Tambe, M. and Wooldridge, M., "The BeliefDesire-Intention model of agency Proceedings of Agents, Theories, Architectures and Languages" (ATAL'99), 1999
[5] Vijayakumar Maragal Venkatamuni."A Society of Mind Approach to Cognition and Metacognition in Cognitive Architecture.", 2008
[6] **Ge**orge Dimitri Konidaris, "Autonomous Skill Acquisition.", 2011
[7] George Dimitri Konidaris, "CST-Constructing Skill Trees by Demonstration.", 2011