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# Smart Agriculture: Robotics is the Future for Modular Farming

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The concept of smart farming comes with the use of Artificial Intelligence (AI) in the field of agriculture. AI is a broad general term used to describe machines that perform tasks, characteristics of inhuman intelligence, which mimics human intelligence - decision making, ability to predict. Machine learning (ML) and Deep learning (DL) are the subsets of AI. Currently, we are in the era of ML and it is estimated that DL may not come in until a decade.

However, robotics is a part of AI and the use of it is accelerated in the recent past. These are used in many activities of agriculture like irrigation, weeding, herbicide and pesticide spraying, surveillance and others. Here let us discuss some technologies developed recently which are efficient and automated.

**Irrigation**

The M2M technology that is, machine-to-machine technology is been developed for smart irrigation to ease communication and data sharing among each other and to the server or the cloud through the main network between all the nodes of the agricultural field (Shekhar *et al.*, 2017). To determine the temperature and moisture content the Arduino and Raspberry Pi3, an autonomous robotic model, was created. Periodically, the data is sensed and transmitted to the Arduino microcontroller, which is coupled to edge-level hardware and performs additional analog-to-digital conversion. To turn on the irrigation water supply, the signal is transferred to the Raspberry Pi3, which has an embedded KNN algorithm. From there, it is sent to Arduino.

The first technique introduced to conserve irrigation water was drip irrigation. Later with some advancements introduction of sensors like soil moisture sensors and raindrop sensors came into use. This sensor enables water on demand the parameters and threshold levels are set while installation and accordingly, they read the moisture level of a particular patch of area and irrigation is allowed only in that particular zone. In this, the two principles are used to develop smart irrigation.

**Dielectric method:** The moisture in the soil is calculated by the sensors which evaluate the moisture content in the soil based on the dielectric constant (soil mass permittivity) of the soil. The amount of irrigation needed can also be determined based on the dielectric constant (Gebregiorgis and Savage, 2006).

**Neutron moderation:** This is another technique for deciding the moisture content in the soil. In this strategy, fast neutrons are launched out from a decomposing radio dynamic source like 241Am/9Be (Long and French, 1967) and when these neutrons slam into particles having a similar mass as theirs (protons, H+), they drastically slow down, making a "cloud" of "thermalized" neutrons.

**Weeding**

Weeding is a very important process in agriculture which helps in acquiring high-quality produce and also helps to conserve the resources. The earlier wedding was done by hand picking but it was a cost-effective and labour-intensive process, therefore, a shift to using the equipment was seen later the use of chemicals was practised. This intensive use of chemicals leads to environmental pollution. To achieve non-chemical weed management a method was developed using robotics.

Pulse high voltage discharge method: One such non-chemical weed control technique that was mostly used to eradicate tiny weeds is the pulse high voltage discharge approach. With just one spark that has 153 mJ of energy and 15 kV of voltage, these tiny weeds which are around 5 cm tall and have a stem diameter of about 2 mm can be annihilated. However, a charge of 20 Hz can eradicate the large weeds, which range in height from 80 to 120 cm and have a stem diameter of 10 to 15 mm. The weeds' stems and roots are negatively impacted by these spark charges, which prevents the waiter from being transported to the different areas of the weeds. As a result, a few days after the spark, the weeds wilt.

Drone assessing the soil moisture content and other parameters

Health assessment drone installed with multi sensors to evaluate the stress level of the crop

Planting drone used in spraying herbicides and pesticides

Crop monitoring drone equipped with advanced cameras for monitoring the crop

**Fig 1:** Different types of drones used for different activities in farming (Source: Modern agriculture drones (Unpaprom et al., 2018).

**Crop spraying**

The UAVs, otherwise called drones, are chiefly established on the innovations of sensors and microcontrollers which are grown especially with an expectation to make up for the nonattendance of the pilot and accordingly empower the trip of unmanned vehicles and their independent conduct (Spoorthi et al., 2017). These drones have been utilized as substance sprayers by farmers for numerous years now and they are considered effective and of great importance in situations of cloudy climate and have also solved the problem of inaccessibility to a field of tall crops, for example, maize (Sugiura et al., 2005; Simelli and Tsagaris, 2015). Also, different kinds of sprayers can be used in drones based on the need like The hydraulic energy sprayer, the gaseous energy sprayer, the centrifugal energy sprayer and the kinetic energy sprayer.

**Crop monitoring**

Drones or UVA are used for crop monitoring. They used advanced imaging sensors to monitor the crop. It is not a new practice for humans to monitor crops from long distances prior it used to be with satellites but drones can achieve it within 400-500 ft height.

ER Hunt et al. (2005) evaluated Digital Photography from Model Aircraft for Remote Sensing on Soybeans, horse feed and corn. The camera from the drone takes a picture of the crop and then the reflectance from the crop is assessed by utilizing the Normalized Green–Red Difference Index (NGRDI) where green and red reflectance are assessed and the result is drawn.

Similarly, Sun et al. (2010) demonstrated the achievability of utilizing a continuous kinematic (RTK) worldwide situating framework (GPS) to evaluate the transplanting stage. They utilized a positive-situation vegetable harvest transplanter retrofitted with an RTK GPS recipient, plant, tendency, and odometry sensors to identify the correct transplanting stage. A low-cost multispectral imaging system was designed and developed using RGB cameras to evaluate crop health status.

Drones are utilized for yield mapping and monitoring, where various sensors are mounted, such as grain moisture content (which compensates for variations in grain moisture), grain fow sensor (which determines the volume of grain gathered), GPS antenna (which receives satellite sign), yield screen show with GPS receiver (which geo-references and records information), header position sensor (which distinguishes estimations logged during turns), and travel speed sensor (which determines the separation the join goes during a specific logging interim).

**Conclusion**

Robots have the power to completely change the agricultural industry and bring in a new era of production, sustainability, and efficiency. Farmers may overcome historical obstacles and meet the rising need for food in a world that is changing quickly by utilizing automation. As this agricultural revolution comes to a close, utilizing creativity and teamwork will be essential to maximizing the potential of agricultural robots to feed the world. The Indian farm company Simply Fresh follows a "Farm in a Box" practice where from sowing to harvesting up to the delivery of the produce everything is automated which is the best example of smart agriculture in recent times.

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