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Working of System Operation

The flowchart in Figure X lays out the full operational sequence for the AgroPatrol system. It shows how the main subsystems work together during actual field use. After activation, the power management part checks the energy available from the battery and solar setup. Charging circuits use DC DC converters to steady the power supply. This makes sure every module gets the right voltage and current levels. The controller only starts the boot process for the motor driver, microcontroller, and Raspberry Pi board once the voltage levels hit their working thresholds.

Now the electronic parts are up and running. AgroPatrol moves into a loop of ongoing monitoring. The sensing components start collecting data on soil moisture at regular times. They also grab environmental details and clear crop images. Moisture sensors produce analog signals that get cleaned up, turned into digital form, and sent over to the main processor. Meanwhile, the camera takes pictures to check out things like plant color, texture, and signs of stress. All this data gives the key insights needed to understand the field's overall state.

At the same time as sensing, the navigation and movement system figures out where the robot is. It uses a mix of GPS signals, wheel encoder counts, and readings from nearby sensors. The differential drive setup keeps updating the robot's position and orientation. Obstacle finders keep an eye on the path ahead for things like rocks, plants in the way, or uneven ground. This setup keeps the position tracking and path planning solid, no matter what the terrain throws at it.

Everything from the sensors heads to the central processing and control area. There, fusion methods pull together the moisture data, image details, and environment info into one clear picture of how the crops are doing. The system checks if the latest readings stray from set limits or normal plant health scores. When it spots issues, like lower ExG numbers, quick drops in moisture, or signs of pests, the decision part kicks in an adjusted reaction.

If it picks up physical blocks in the way, the navigation control tweaks the robot's route. It does this by changing the wheel speeds to turn or stop as needed based on how close the obstacle is. This keeps the robot moving without crashes through smart path changes. For problems with crop health, the spraying part turns on. The control figures out the right amount of chemical based on nozzle specs. It sets the spray time to match how bad the stress looks. This way of spraying hits just the spots that need it and cuts down on wasted materials.

Things keep going smoothly if no problems show up. AgroPatrol follows its set route while updating its location and pulling in more sensor info every so often. Right alongside that, the IoT link packs up the handled data. This includes soil measurements, weather stats, movement updates, and photo captures. It sends all this to a far-off control panel. Users get real time views, saved records over time, and warnings if the robot hits serious trouble.

The whole sense process decide act loop runs on until the robot covers the planned area. Once the route ends, AgroPatrol shifts to wrapping things up. It does one last send of data, logs the mission details, and slowly shuts off parts that do not need power. This saves battery life and avoids full drain. The careful end process boosts how dependable the system is. It makes field checks more even and lets the robot run with little hands on help from outside.