Journal of Research and Review in Science Vol. 3, November 2004. pp. 17 - 19

ELECTRONICS IN AGRICULTURE

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ABSTRACT

The impact of electronics in agriculture cannot be ignored owing to the increase in vital use of electronics in such areas as radio-telemetry for remote scientific monitoring of livestock; global positioning system (GPS) for identification of grazing areas; hand-held data loggers for weed mapping and yield mapping; electronic control of agricultural equipment e.t.c. The paper seeks to examine the above and related issues.

INTRODUCTION

Modern farmers are becoming increasing involved in cost cutting strategies. One method of doing this is to increase the use of electronics in agriculture, typically, on a tractor, for linkage control and gear management including speed limitation. For the purpose of farm management all the information from the tractor e.g. fuel, acres, time, can be recorded and used. Electronics can be used to control other equipment. e.g. sprayers and ploughs. The benefits of electronics are finances, performance, comfort and safety. Global positioning systems are also used with reference to yield mapping grazing area identification, weed mapping and environmental protection for livestock applications.

Electronics in Agriculture

An implantable radio-telemetry system is a useful electronic equipment for remote monitoring of heart rate and deep body temperature in poultry. A pair of electrocardiogram electrodes are fixed to the outer surface of the pectoral muscles and the transmitter and the power supply inserted into a subcutaneous pocket over the pectoral while a thermistor lead is inserted through an incision in the peritoneal. Recordings were made (Kettlewell,1997) throughout a 24h period in 6-weeks old broiler chicken maintained with a photoperiod of 14h light, 10h dark with lights being switched off at 05.00h. Peak heart rate (HR) occurred mid-morning and the minimum HR occurred in the middle of the dark period with the minimum body temperature. Maximum body temperature was recorded in the hour before darkness. Both HR and body temperature decreased sharply at the end of the light period and increased rapidly at the beginning of the light period.

Patch spraying system is dependent for its operation on the availability of a field map of weed-patch distribution. The strategy for building weed maps is to use a number of different techniques at various times through the season. Techniques may include aerial image interpretation, near-ground capture and analysis, and manual surveying. An important source of knowledge is the farmer who has a qualitative mental record of weed distribution in the field and who regularly walks his fields, thus gaining more knowledge. A compact hand-held data logger, based on a palm-top PC lintal to a differential Global positioning system (GPS) system in a backpack has been developed (Stafford,1996) to aid the farmer during field walking. It can record weed information and position, which is displayed on a screen map for later updating of a master field weed map held on the farm PC. The software has been written to provide a good user interface, data checking of all user input and compatibility with the mapping system used to derive the patch spraying system.

Point distribution model can be used to locate pigs in images. Tillett (1997) has extended the idea to tracking animal movement through sequences of images where a single pigetal is viewed from above. As well as position and rotation, more subtle motion such as bending and head holding can be modeled. This type of model based tracking could be used to characterize animal behaviour. The technique was used on seven sequences and worked well in most cases. Further developments are required to investigate model fitting methods and high level control over the fitting and tracking process.

Within flocks on grazing land contaminated with radioactive fallout from the Chernobyl nuclear accident, certain sheep have comparatively high levels of radiocaesium. To understand why only certain sheep are affected, the precise grazing areas of these animals need to be identified. An animal behaviour and tracking system, that utilizes the Global positioning system (GPS), was developed and tested in upland West Cumbria, UK (Rutter, 1997). The study clearly demonstrates that Global positioning system can be used to track domestic sheep and could be used to identify home ranges and the specific areas giving rise to contaminated animals.

Satellite Technology and Global Positioning System in Agriculture

The complete Global Positioning system (GPS) consists of 24 satellites orbiting the earth (three different orbital planes) and receivers on or above the earth surface. The system was designed and set-up by US military forces. The satellites broadcast signals consisting of information about the satellites and their orbits, and a highly accurate time code based on universal time (GMT). To find positioning using GPS techniques involves use of a receiver whose antenna has an unrestricted view of the sky. By comparing the time code with the time when the signal was received, the receiver on the ground can calculate how far away the satellite is for any given time (using carrier phase measurement). Since the position of the satellite is known accurately relative to the earth surface, the position of the receivers on the ground can be calculated, using the technique of resection (finding an unknown location from observations on known locations).

In principle the GPS is accurate to millimeters, but because of the military significance of this technology, publicly available instruments are limited to instantaneous accuracy of 7-100 m with a 99% certainty. However the use of two instruments where one is placed at a known location allows correction of error introduction into the signal in order to degrade accuracy. Corrections are made by radio link with the base station or by, post-processing. This procedure is known as differential GPS. GPS instruments can be used to sample positions at a rate of one per second, storing them in memory. The co-ordinates are recorded in latitude-longitude form based on world Geodetic system and can be unloaded into a GIS using translation and transfer packages.

The GPS consists of 21 satellites and 3 active spares. Cyding the earth twice daily, these satellites are distributed among size orbits approximately 20-200 km, above the earth. The satellite which is in near circular orbit (i.e eccentricity is approximately zero) in inclined to the equator to about 55^0, each satellite continuously transmitting precise timing forms, including satellite status, orbital data and clock corrections.

A typical GPS receiver consists of an antenna, signal processing electronics and processor. The primary function of a receiver is to acquire signal, recover orbital data, make range and Doppler measurements and process this information in real time to obtain the user's position, velocity and time.

Differential GPS (DGPS) is an electronic technique that allows you to remove the selective availability satellite (S/A) and atmospheric error from the position data. This improves the accuracy of the GPS positioning. Differential positioning requires two GPS units. One unit is placed on location for which the co-ordinates are precisely known. This unit is commonly known as the base unit. The other is operated at the location for which accurate positioning information is desired. This unit is commonly called the field unit. The base unit calculates corrections to the data being received from the satellites. These corrections are applied to satellite data received by the field unit.

Differential GPS works because most of the error in a satellite signal is the same for all users in wide geographic area. Using differential D-GPS, one may achieve an accuracy of 1-5 meters for static positioning and 3-10 meters for kinematic application. The method is commonly referred to as "relative positioning' and it is purposely associated in application with agricultural surveying, weed mapping, yield mapping etc in agriculture and related fields.

CONCLUSION

The impact of modern electronics in agriculture cannot be over emphasized as demonstrated in the few application cited above which included remote scientific monitoring of livestock, global positioning system (GPS) and its advancement, differential global positioning system (D-GPS) for applications in agricultural surveying, grazing area identification, weed mapping, yield mapping and contaminated area identification for environmental protection of livestock. GPS is a space-based system that will revolutionize agricultural operation and geodetic positioning and even used to monitor local and global deformation and aerial triangulation without ground control. These applications are in no doubt essential to the production of various kinds of agricultural maps and consequently to many facets of national development.

REFERENCES

1. Kettlewell P.J., Michell M.A., Meeks I.R. (1997). "An umplantable radio-telemetey system for remote monitoring of heart rate and deep body temperature in poultry"
2. Stafford J.V., Bars J.M., Ambler B. (1996). "A hand-held data logges with integral GPS for producing weed maps by field walking" Journal of computers and Electronics in Agriculture 14(2-3): 235-247
3. Tillett R.D., Onyango C.M, Merchant J.A. (1997). "Using model-based image processing to track animal movement" Journal of Computers and Electronics in Agriculture 17(2):249-261
4. Rutter S.M., Beresford N.A., Roberts G (1997). "Use of GPS to identify the grazing areas of hill sheep" Journal of Computers and Electronics in Agriculture 17(2) : 177 - 188
5. Purser, Michael (1998). Computers and Telecommunications Networks. Blackwell Scientific Publications, Oxford U.K.