Aerobiology, biophysical studies through integration of zigbee communication protocols in fixed wing air vehicle for dam regions

Syed Mohammed Shoaib[1], Shaik Abdul Khader Jilani[2]

1-Engineering Physics Lab, MANUU Poly DBG Off Campus, School of Sciences, Maulana Azad National Urdu University, Gachibowli, Hyderabad-500032, Telangana State., India

2-Department of Electronics& Communication Engineering, Madanapalli Institute of Technology and Sciences Madanapalli-517325, Chittoor District, A.P., India

E-mail: dr.smdshoaib@manuu.ac.in

Abstract

Aerobiological sampling using unmanned Micro Air Vehicles (MAVs) on Long-Term Behaviour and Environmentally Friendly Rehabilitation Technologies of Dams is an exciting research field blending various scientific and engineering disciplines. The biological data collected surroundings the Dams using MAVs helps to better understand the atmospheric transport of microorganisms. Aerobiological research aims to improve our understanding of these aerial organisms to ensure human health and to help sustain and safely manage terrestrial ecosystems, including important food resources. Airborne bacteria, fungi, viruses and pollen are responsible for many human respiratory diseases and allergies. Autopilot-equipped MAVs can accurately sample along pre-defined flight plans and precisely regulated altitudes with help of GPS (Global Position System). They can provide even greater utility when they are networked together in coordinated sampling missions: such measurements can yield further information about the aerial transport process quickly and efficiently. Accordingly, the problem of coordinating multiple autonomous vehicles to address scientific and other missions has enjoyed increased attention from researchers.

Keywords: Communications Engineering, Aerobiology Instrumentation, Biophysics Engineering and LTBD.

1. INTRODUCTION

In this present investigation, flight vehicle path planning, real-time sample analysis, control and coordination strategies are considered for unmanned autonomous aerial vehicles with the help of Zigbee protocols. A time-optimal path planning algorithm, that is simple enough to be solved in real time, is derived based on geometric concepts. The work is part of a larger effort that focuses on the validation of atmospheric dispersion models of Dams developed to predict the spread of bacteria and plant diseases in the lower atmosphere. The use of Zigbee protocols allows us to control MAV and monitor various sensors in real-time with distributed control. Low power, long distant and authentic data communications features of Zigbee are fully utilized in the present LTBD work. The present novel method would be a significant improvement upon the existing system due to the presence of an Zigbee based control and monitoring system.

The objective of the present investigation is to implement advanced communication Zigbee protocol, which provide most reliable and secure data transfer for guided unmanned aerial platforms along with GPS technology which can locate the MAV with considerable accuracy and collect Aerobiological sample from pre- determined geographical Dam locations at accurate altitudes.

In this work path planning and control strategies will be focused that are to be used in aerobiological sampling field experiments surrounding the Dams. The area surrounding the dam is very important for aerobiological study as this area harbor new and artificial ecosystem compared to other area. Artificial water level control at the Dam also influence the ecosystem of the surrounding area. Aerobiology is a branch of science that studies the processes and factors that influence the motion of aero biota in the atmosphere. Aero biota may include plant and animal pathogens, insects, seeds and pollen, or other living organisms that use the air to change habitat. The atmosphere of the Earth is primarily composed of the mixture of two gases, nitrogen (78%) and oxygen (21%), commonly known as air. Other than gases, air also contains small particles, like dust, and it may also host microscopically living organisms. Although many of these aerial living organisms have a significant impact on humans, little is known about the processes and mechanisms that affect their motion. One may face numerous fascinating questions when dealing with aerial life forms: In addition to questions regarding their role, and interaction with other living organisms, for example, one is concerned with the aerial transport mechanisms that transfer them from one location to another. Aerobiological research near the Dams aims to improve our understanding of these aerial organisms to ensure human health and to help sustain and safely manage terrestrial ecosystems, including important food resources.

2. EXPERIMENT

Airborne bacteria, fungi, viruses and pollen are responsible for many human respiratory diseases and allergies. Pulmonary tuberculosis, Diphtheria, or Influenza an indirect impact on humans of these living aerial organisms is the devastating effect of plant diseases.

A risk management system is needed that would help growers make informed decisions about fungicide use, or sanitation. In order to accurately assess the risk of an infection at some location spreading to other areas, especially in Dam located regions, mathematical models of varying complexity may be employed to predict the trajectories of the sporangia, given ambient wind and other environmental conditions. It is understood that long-distance aerial transport plays an important role in the evolution of plant disease epidemics. This research investigation also aims to inspire other research teams to continue venturing into the MAVs with an increased concentration in the applicability aspects using latest communications and global position systems on Long-Term Behaviour and Environmentally Friendly Rehabilitation Technologies of Dams (LTBD).

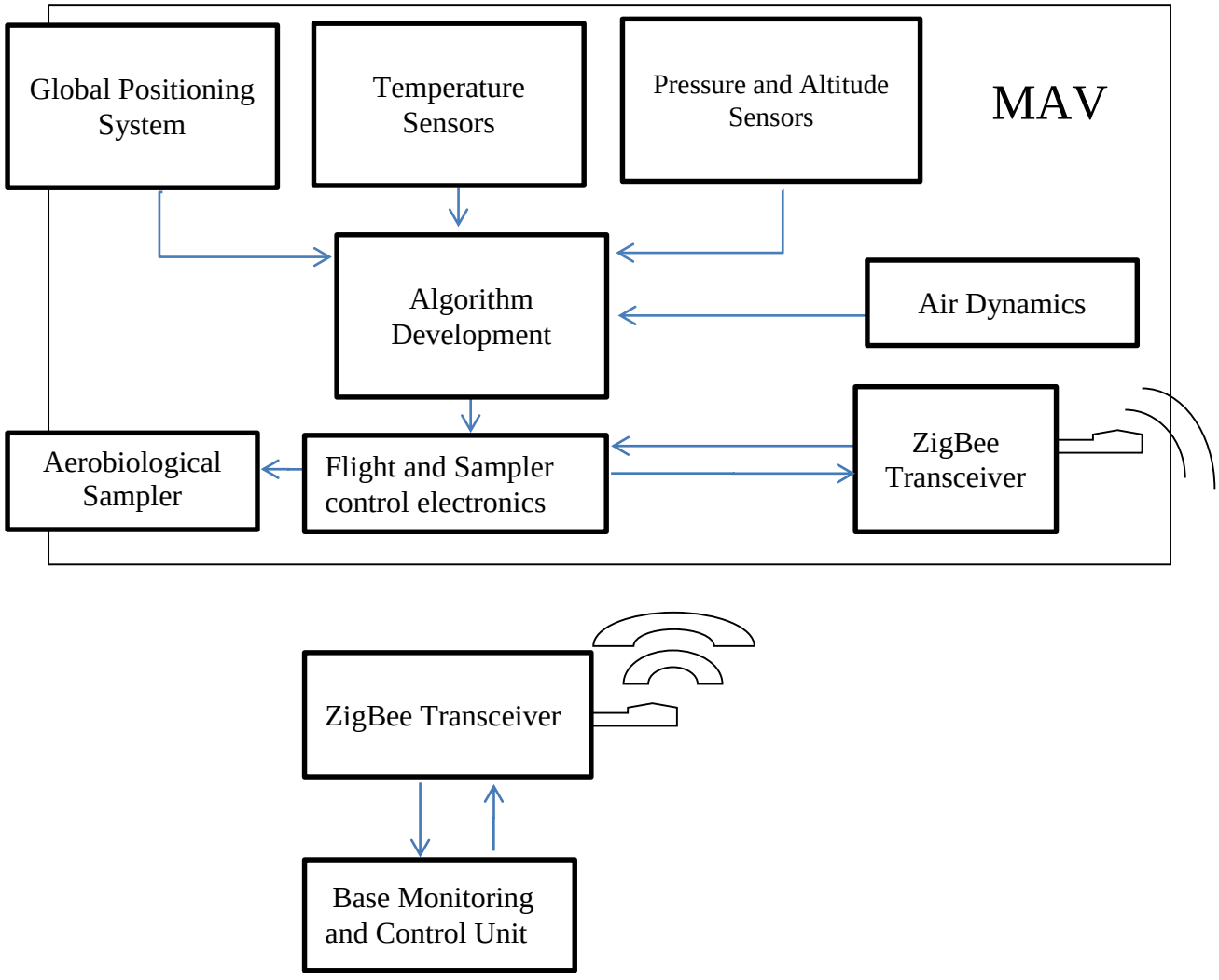

Figure 1: Flowchart depicting the various stages of the investigation

The development of a novel setup for this purpose would aid the research in various applications and industries like LTBD, agriculture, disaster affected areas, identification epidemic affected areas, air pollution control and monitoring etc. thereby opening up research options for faculty and students. Various workshops and seminars would also be conducted across Universities in order to ensure the dissemination of all knowledge gained during the investigation among University students.

Figure 2: Unmanned Micro Air Vehicle (MAVs)

3. RESULT

The studies indicate that micro-organisms vary in abundance, distribution and diversity in the atmosphere. Yet, the air remains the least understood environment from a biogeography perspective. Patterns in the variation of micro-organisms in the atmosphere have not been well documented, nor have the processes that underlie these patterns been identified. Here, we consider defining attributes of land, water and air environments, and how these attributes may contribute to similar and different biogeography patterns across these domains. Building on a rich history of research in terrestrial and aquatic systems, we explore two patterns that are likely to play an important role in shaping the emerging field of air biogeography: environmental diversity gradients and the existence of biogeographic Dam regions. Ultimately, a more unified understanding of the biosphere will entail comparing and contrasting these patterns across the lithosphere, hydrosphere and atmosphere.

A few different papers comprising of a few different approaches have been published on the use of the algorithms that are the topic of this research. Background information from a variety of sources has been studied to augment our knowledge and understanding of the technologies. In this present investigation we aim to draw from the substantial applied research available in this area to develop a novel application for MAV for the purposes of aerobiology studies in LTBD regions.

4. DISCUSSION

Our country is very active in aerobiology studies for the last six decades and contributing effectively to the world. The pioneer Aerobiologist from North East India was H.K. Baruah, Ph.D. (Cantab., 1942) and is now regarded as the Father of Aerobiology in the region. He started his aerobiological research works in the region after visiting Imperial College of Science and Technology, London where he worked with P.H. Gregory, F.R.S. under Colombo plan fellowship (1955-56).

"THE INDIAN AEROBIOLOGICAL SOCIETY" (IAS)" is established in 1961 and is located at the Division of Palynology and Environmental Biology, Bose Institute, Calcutta. The society is affiliated with the International Association for Aerobiology. It is responsible for publishing research papers in Indian Journal of Aerobiology which is noted Indian Journal for Aerobiology. This society conducts various workshops and conferences in the field of Aerobiology.

Recently we entered in to development of MAVs, currently various organizations and research institutes like, SBMJCE NAL, IITs, IISc, MSRSAS etc. are undertaking research in the field of MAVs. A research work by a group from IIT, Kanpur focuses on Feature Based Object Tracking Using PTZ Camera. But our present work is very innovative and we wish to extend the scope and applicability of this by fitting GPS on MAV and enabling the MAV to locate exactly on required location and altitude for the study of Dams. However, many International Research workers utilized this MAV for different studies.

5. CONCLUSIONS

An MAV system with the present Zigbee control can patented upon maturation of the results obtained through different funding agencies. Once a patent is secured, the technology could be used to estimate pollens distribution on crop fields, Ariel bacteria / virus estimation over Dams atmosphere, epidemic plant virus estimation in crops etc. The potential uses with respect to agriculture and epidemic virus distribution studies make it ideally suited for various environmentally socially beneficial activities. Various technical experts are being consulted for the development of the algorithms and the MAV. Technical consultancy to various Central Universities, State Universities, various colleges and industries like town planning, DRDO, Armed Forces, Large Dams, Private Security Agencies etc. would be provided after the investigation results reaches a

certain degree of completion and robustness. The system once developed can be commercialized due to applicability in various environmental, agricultural and health related activities. Revenue generation could be expected to begin shortly after the successful demonstration of the systems capabilities through proper channel.

6. ACKNOWLEDGMENT

The Author is thankful to **Dr. Mohammad Aslam Parvaiz** Sir Honorable Vice Chancellor MANUU and **Dr. Shakeel Ahmad** Sir Joint Secretary UGC, Govt. of India, New Delhi presently deputed as Pro Vice Chancellor for our MANUU Central University, Hyderabad for their encouragement to do Research Activities for the overall development of Students and Faculties in our University.

7. REFERENCES

1. D. E. Aylor, M. T. Boehm, and E. J. Shields. Quantifying aerial concentrations of maize pollen in the atmospheric surface layer using remote-piloted airplanes and Lagrangian stochastic modeling. Agricultural and Forest Meteorology, 45:1003–1015, 2006.
2. J. N. Bakambu and V. Polotski. Autonomous system for navigation and surveying in underground mines: Field reports. J. Field Robot., 24(10):829–847, 2007.
3. D. G. Schmale III, B. R. Dingus, and C. Reinholtz. Development and application of an autonomous unmanned aerial vehicle for precise aerobiological sampling above agricultural fields. Journal of Field Robotics, 25(3):133 – 147, 2008.
4. S. A. Isard and S. H. Gage. Flow of Life in the Atmosphere. Michigan State University Press, East Lansing, MI, 2001
5. R. M Baxter, Environmental effects of Dams and Impoundments, Annual Review of Ecology and Systematics, Vol .8, 255-283, 1977.
6. Marcus W. Beck, Andrea H. Claassen & Peter J. Hundt, Environmental and livelihood impacts of dams: common lessons across development gradients that challenge sustainability, IJRBM, iFirst, 1-20, 2012.