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R. R. EVERETT JUN 26 1950

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING

Report No. 1

Prepared by: D. R. Israel

PROGRESS REPORT TO THE DEPARTMENT COMMITTEE ON GRADUATE STUDY AND RESEARCH

SUBJECT OF RESEARCH: The Application of a High Speed Digital Computer to the Present-Day Air Traffic Control System. (M. S. Thesis)

Period Covered by this Report: To June 10, 1950

Student Working on Research:

D. R. Israel

Noted by:
Res. Lab. Office ________
Grad. Comm. ________
Supervisor ________

Building: Barta

Expected Date of Completion:

September, 1950

Supervisor: Prof. William Linvill

Detail of Work Currently Active: Study of operation of present system of air traffic control and preliminary investigation towards programming.

Expected Date of Completion of this Detail: June 30, 1950

Statement of Progress Since Last Report:

A more detailed study has been made of the present system of air traffic control, with particular emphasis being paid a) to the coordination between air traffic control centers and the tower and approach control facilities at the airports, and b) to the limitations and shortcomings of the present system with regard to the capacities and capabilities of human controllers. A large part of the results of this study appears as the second and third chapters of an Electrical Engineering Department Seminar entitled "Air Traffic Control". This seminar will shortly be issued as Report R-188 by the Electronic Computer Division of the Servomechanisms Laboratory.

In further preparation for the writing of flow diagrams and computer programs, the instruction manuals and study guides of the Civil Aeronautics Administration have been obtained and are being carefully examined. These efforts have already resulted in a greater understanding of the detailed operation of the present system of control, and have gone a long way towards indicating those situations in which it would not seem feasible to delegate complete control to a digital computer. These studies are continuing.

One of the major considerations involved in this thesis study is that of the storage of information in the computer. Much of the data which presently exists in the minds of the human controllers, on charts, on maps, in weather reports, and on flight progress strips must be stored in the computer. This, of course, must be in addition to the storage of detailed computer instructions. An example of this data storage is the requirement that the computer have a knowledge of the geometrical configuration of the airways (including the reporting points, distances between these reporting points, and the minimum safe altitudes which can be flown), a knowledge of the prevailing weather conditions (including visibility, and magnitude and direction of the winds at various altitudes), a current and accurate knowledge of the aircraft expected over these reporting points (including aircraft identification, time, altitude, speed, and direction on the airway) and a knowledge of the airport tower and approach control facilities at the various airports. In studying the means of storing this data, various problems arise due to the fact that part of the above-mentioned information regards conditions on the path (airway) <u>between</u> two adjacent reporting points, while the remainder refers to conditions <u>at</u> or <u>above</u> the reporting points. (The names <u>path data</u> and <u>point data</u> have been adopted as a means of distinction.) A preliminary study of some fifteen pages in length has been made of this problem and of a possible method of solution.

Estimates indicate that of the two factors of computer storage capacity and computer speed, it is the former which will be heavily taxed in the proposed computer application. It is expected that the heaviest drain on the storage capacity (other than that of the computer programs themselves) will be the necessity of storing the large quantity of information concerning the expected arrivals of aircraft over the various reporting points. If a fixed number of registers, say N, were allocated to <u>each</u> reporting point for this purpose, then N would have to be chosen large enough to handle the highest expected traffic density conditions at any one point. One could allot a different number of registers to each point dependent upon the <u>maximum</u> expected density at that point, but this proposal seems to introduce particular problems of its own. It would seem to be a better idea to assign only a common reservoir of registers which could then be allocated as conditions required. A study is presently progressing with regards to this latter proposal and an investigation is being made of how to obtain maximum utilization of the storage space.

At the present time the CAA makes extensive use of the decimal system and alphabetical abbreviations in transmitting and storing information. This is not suitable for the computer which operates with the binary system of notation. Such binary notation would be meaningless to human controllers, tower operators, or pilots, and hence the computer must be able to readily convert the alphabetical and decimal notation to the binary system, and vica versa. This problem is highlighted by the fact that when a situation arises which the computer is unable to handle and which requires human intervention and/or assistance, the computer must a) know what information it must make available to the human controller, and b) must be able to present this information in a usable form. These problems are now being studied.

As was mentioned in the thesis proposal, an attempt will be made at devising or constructing computer flow diagrams which will not only indicate the control and instruction sequence, but which will show the flow of information from the computer storage to and from the outside world. The first attempts at such flow diagrams seem to indicate that this can be done successfully.

Signed: D. R. Israel

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